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Sangamon County Solid Waste Management System Analysis

Roy F. Weston, Inc, West Chester, PA

Prepared for

Illinois Inst for Environmental Quality, Chicago

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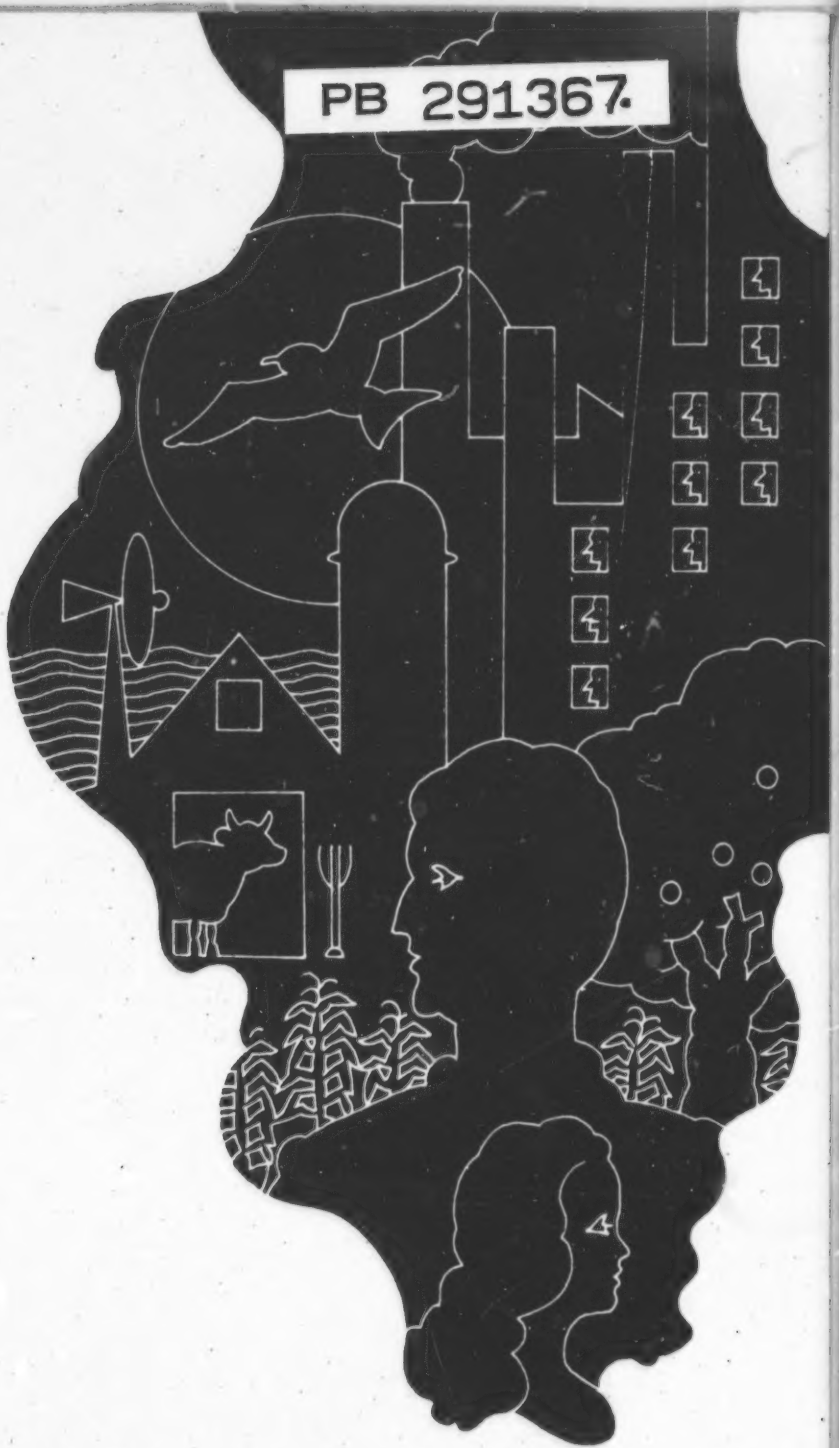

SANGAMON COUNTY
SOLID WASTE MANAGEMENT SYSTEM ANALYSIS

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SANGAMON COUNTY
SOLID WASTE MANAGEMENT
SYSTEM ANALYSIS

Roy F. Weston, Inc.

(IIEQ Document No. 74—11)

Project No. 40.001

State of Illinois

Illinois Institute for Environmental Quality

June, 1974

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SOLID WASTE
MANAGEMENT PLANNING

The Need for Advance Planning in Illinois

In July, 1970, the Illinois General Assembly passed the Illinois Environmental Protection Act. This law expresses the determination of the people to improve the quality of the environment in Illinois. The Act addresses problems of air, water, land and noise pollution.

In 1973, the Illinois Pollution Control Board adopted new regulations for sanitary landfills. These regulations are enforced by the Illinois Environmental Protection Agency. The permit and inspection provisions established under these regulations are among the most comprehensive and vigorous in the United States. Each landfill operator is required to apply for a permit by April 27, 1974. The expense of meeting Illinois design and operating standards has and probably will cause some marginal landfill operations to close, thereby eliminating some environmentally unacceptable, but convenient, disposal sites.

The dwindling number of solid waste disposal sites has caused concern among municipal officials and private solid waste companies. Efforts to aquire new sites have often been thwarted by citizens who recognize the need for such facilities, but would rather see them located somewhere else.

The increased costs associated with everything these days have strained municipal budgets. Solid waste management is a large budget item. Elected officials are asking: Can this be reduced?

Over half of the solid waste in Illinois is managed by private companies. Their costs are increasing, and so are the rates charged to their clients. Public officials are asking: What is the cost of solid waste management? Should we go into business for ourselves?

In 1973, the energy crisis reinforced the long-standing argument by

environmentalists that something should be done to recover the resources going into solid waste. Solid waste managers now must cope with the added complexities of unproven recovery systems and an uncertain market for recovered commodities.

These and other pressing problems require planning. This study provides a basis for that planning by examining the economics of current solid waste management practices and proposed regional management strategies.

State Solid Waste Plan

The State Solid Waste Management Planning Project will examine the solid waste needs of Illinois and make recommendations as to actions that can be taken by the State to improve solid waste management generally. The Solid Waste Management Task Force of the Illinois Institute for Environmental Quality recognized from the start that solid waste management is a local responsibility and is subject to the specific desires of the people as to the services desired and the manner of satisfying these desires. Consequently, the task force suggested that the principal thrust of the State planning project should be to assist the work of local and regional planners who must prepare the specific recommendations for local officials.

This report is an analysis by the State and its consultants of several alternatives available to a specific region. Basic data used in the analysis was gathered by the regional planners, processed by the consultants, and rechecked by the regional planners. Elsewhere in the State plan, the planner will find reference data on the natural features of the State which will have an impact on solid waste management activities.

The Analytical Process

People and their activities produce solid waste. The first step in the planning procedure was to determine population and employment. Basic population projection data was generated by Argonne National Laboratory using historic census data and a predictive model. These projections were checked by the regional planner using local data and projections by the Illinois Office of Planning and Analysis (OPA). Tables 1 and 3 show examples of population and employment projections. Employment data was taken from the

Table 1

PROJECTED POPULATION EXAMPLE

LOCATION	1970	1975	1980	1985	1990	1995	2000
City A	305	305	350	360	390	400	410
City B	39,992	44,500	48,500	51,400	54,000	57,100	59,800
City C	2,435	2,780	3,010	3,230	3,440	3,690	3,910
City D	26,396	27,900	34,400	39,100	43,800	49,000	54,100
SUB TOTAL	69,128	75,385	86,260	94,090	101,630	110,190	118,220
UNINCORPORATED	21,754	23,400	24,200	24,800	25,300	25,900	26,400
COUNTY TOTAL	90,882	98,785	110,460	118,890	126,930	136,090	144,620

Table 2

AN ILLUSTRATION METHOD OF MUNICIPAL SOLID WASTE GENERATION

(1) Political Subdivision	(2) 1970 Population	(3) Area, $mi.^2$	(4) Population Density (2) ÷ (3)	(5) Log (4)	(6) 1.54 X (5)	(7) Generation Factor (6) - 0.68 #/cap./day	(8) Collection Rate (2) x (7) #/day	(9) Collection Rate (8) ÷ 285.7 ton/week
City A	305	0.17	1,794	3.25	5.01	4.33	1,320	4.6
City B	39,992	11.37	3,517	3.55	5.46	4.78	191,161	699.
City C	2,435	1.28	1,902.	3.28	5.05	4.37	10,641	37.
City D	26,396	6.06	4,356	3.64	5.60	4.92	129,868	455.
Co. Remainder	21,358	1,157.	18.7	-	-	3.4	72,617	254.

Table 3

AN EXAMPLE OF THE EMPLOYMENT PROJECTIONS

SIC		1971	1975	1980	1985	1990	1995	2000
City B	207	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	2432	25	29	31	35	36	40	42
	3272	3	0	0	0	0	0	0
	358	1,500	2,470	2,750	3,020	3,220	3,630	4,010
City C	243	15	15	15	15	15	15	15
	271	4	1	0	0	0	0	0
City D	275	15	21	27	32	37	43	49
	278	60	79	100	140	170	210	240
	301	225	225	225	225	225	225	225
	327	32	32	35	35	35	35	35

Illinois Manufacturers' Association Directory as an historic data base. Employment projections are expressed in 3- and 4- digit Standard Industrial Classification (SIC) code (Table B-1, Appendix B).

Approved population projections are then multiplied by waste generation factors to give the municipal solid waste load (i.e. the residential and commercial wastes generated within a community).

Table 2 is an example of a tabular solution in which population is translated into a solid waste generation rate. (A more detailed explanation of the columns and the computational method is contained on Page B-1, Appendix B). Similarly, Table 4 gives a sample calculation in which employment is translated into tons of industrial wastes. The conversion factors (Table B-1, Appendix B) for converting employment data into tons of waste were derived by the consultant from data supplied by the USEPA. Table 5 shows, where there is no centrally located municipality, how the residential waste from unincorporated areas is allocated (on the basis of percentage of area) and combined with municipal and industrial wastes for the purpose of subsequent analyses. Wastes from unincorporated areas are considered to be located at the centroid of the township.

For long-term planning, consideration must be given to the annual change in generation rates. The computational methodology is shown on Table 6. A 2% and 3% per year increase in the generation factor was used for cities with more than 10,000 people and less than 10,000 people respectively.

Total waste quantities for the present (1973) and a future date (1990) are presented on Table 7. These waste quantities are, in turn, provided as input to a computerized model. The computer then determines the cost of hauling waste from the centroid of each source to each specified processing or disposal site. Transportation costs are added to site annual operating costs to determine a total annual system cost. It is within the capability of the computer model, if it is so instructed, to select the combinations of sources, processing facilities and ultimate sites which given the least (optimum) system cost.

Table 4

EXAMPLE OF INDUSTRIAL WASTE LOADING CALCULATION

(1) Location of Political Subdivision	(2) SIC Code	(3) Number of Employees in 1971	(4) Generation Factor (Ton/Empl/Yr)	(5) Production Rate (Ton/Yr) (3) x (4)	(6) Production Rate (Tons/Week) (5) ÷ 52	(7) Total Industrial Waste For Each Source (Ton/Week)
City A						0
City B	207	1,000	3.3	3,300.	63.4	
	2432	25	232.	5,800.	111.5	
	3272	9	154.	1,310	26.1	
	358	1,500	1.5	2,250	42.2	243.2
City C	243	15	21.7	3 325.5	6.3	6.3
City D	275	15	1.1	16.5	-	
	278	60	2.6	156.	3	
	301	225	3.7	833.	16	
	327	32	15.	480.	9.2	28.2

Table 5

EXAMPLE OF COMPOSITE LOADING SHEET FOR BASE YEAR - 1973

Source Name	I.D#	SIC Load (Ton/Week)	Municipal Load (Ton/Week)	Area for Division of County Remainder $(Miles)^2$	Load due to County Remainder (Ton/Week)	Total Load (Ton/Week)
City A	101	-	4.6	9.7	54.6	59.2
City B	102	243.2	699.	10.	56.3	998.5
City C	103	6.3	37.	10.4	58.6	101.9
City D	104	28.2	455.	15.	84.5	567.7
				45.1	253.98	
County Remainder -		-	254			1727.3

Table 6

AN EXAMPLE OF THE COMPOSITE SHEET FOR WASTE LOADS (Ton/Week) FOR 1990

Source Name	I.D.#	1990 Industrial Load (Ton/Week)	1970 Generation Rate (#/cap./day)	% Increase Per Year	Total % Increase	1990 Generation Factor (#/cap./day)	1990 Municipal Waste Loads (Ton/Week)	County Area Factor	County Remainder Based on Area (Ton/Week)	1990 Total Waste Loads (Ton/Week)
City A	101	-	4.33	3	60	6.9	9.4	36	94.3	103.7
City B	102	360	4.78	2	40	6.35	1264.	48	125.7	1389.7
City C	103	6	4.37	3	60	6.99	84.3	64	167.7	252.
City D	104	36	4.92	2	40	7.87	1207.	36	94.3	1301.3
County Remainder			3.4	3	60	5.44	482	184		3046.7

Table 7

EXAMPLE OF THE STUDY PERIOD SOURCE INVENTORY

SOURCE NAME	SOURCE ID NO.	1973 VALUES QUANTITY (Tons/Week)	1990 VALUE QUANTITY (Tons/Week)
City A	101	59.2	103.7
City B	102	998.5	1389.7
City C	103	101.9	252.
City D	104	567.7	1301.3

In addition to sources and waste quantities, the computer must be given cost parameters for transportation and for the operation of the solid waste management system specified. Unit costs for the disposal systems tend to be lower as the quantities increase. Such variable cost factors are best described by cost curves which were incorporated into the computer input. These cost curves are shown in Figs. B-1 and B-2, Appendix B.

In developing the planning factors and cost curves, the consultant was faced with the problem of picking a finite value for a given function when, in actuality, that function could be described by a range of values. The values given here are neither the highest nor the lowest, but an estimate of current conditions. They were adjusted to 1973 cost levels using the Engineering News-Record construction cost index. Where appropriate, assumptions are listed.

Computations do not include the cost of solid waste collection. It is assumed that, regardless of the management system used, the waste must be collected. Whether it is collected once a week or twice a week, at the curb or at the back door, in plastic bags or in 32 gallon cans, are matters of local preference. The alternatives addressed in this study include the cost of moving from the centroid of the collection area to an intermediate or final disposal site.

Aside from taking the drudgery out of the thousands of calculations required, the computerized model permits the planners to examine a range of management alternatives. The strategies thus examined and reported here were proposed and analyzed by the regional planner with assistance from the State's consultants.

Resource Recovery

These analyses take a conservative view of the economics of resource recovery alternatives. As of March, 1974, there were no large scale resource recovery systems operating in the United States. Certain demonstrations projects are operating successfully in Franklin, Ohio and St. Louis, Missouri. Larger systems have been designed and several are under construction. We can

predict operating and capital costs better than we can predict the off-setting revenues from the sale of recoverable resources. Table 9 gives recent prices for the secondary materials present in typical municipal waste. These prices are subject to the usual variations of the commodities market, as well as regional variations in transportation costs. Table 10 describes eight levels of resource recovery activities and the expected revenue (based on Table 9 prices). The decision to adopt a resource recovery system will entail an evaluation of the risk involved in the fluctuating market values.

Uses of This Report

The results of this analysis are intended to assist the regional planner in preparing recommendations for local decision makers. The analytical techniques used are based upon averages and generalized planning factors developed in 1973 and cannot be expected to reflect the exact local cost situation. The usefulness of this regional analysis is to show the relative economic merits of alternate management systems, thus enabling the planner to separate the most feasible alternatives from the least feasible.

This report includes basic data, planning factors, and sample calculations so that the regional planner can make specific adjustments later on. It is to be emphasized that the least cost solution is not necessarily the best. The recommended solution will be that which combines economy with regional desires and constraints. To prepare such recommendations is the task of the regional planner.

Future Planning

It is expected that regional planners will need to up-date their plans and to consider other strategies. It is the intention of the Illinois Institute for Environmental Quality to maintain the capability for providing these regional analyses.

TABLE 9

RESOURCE RECOVERY VALUE FOR FERROUS AND NONFERROUS METALS, GLASS, FIBERS AND HEAT VALUE

Materials Recovered	Conc. In MSW (%)	Recovery (%)	T /100T MSW	Delivered Price	Trans. Charge (5)	Net Credit	Credit $/Ton Of Input Solid Waste
Ferrous Metal (6)	7.5	100	7.5	$56	$ 46	$11.7	$ .82
#2 Bundle	7.5	100	7.5	20 (10-30)	6	10	0.75
Madison (3)	7.5			51	6	14	1.05
Scrap Steel Jan. 73 (4)				86	6	45	
Jan. 74 (4)						80	
Scrap Steel Incinerator Residue			7.5	12 (10-14)	5	7 (5-9)	.53 (.40-.72) (.42 (6))
Aluminum	1.0	100	1.	200	50	150	1.50
Copper Zinc Fraction	.5	100	.5	240	50	190	.95
Copper Scrap (Jan. 73) (4)				860	50	810	
(Jan. 74) (4)				1360	50	1310	
Tin Scrap (Madison (3))				4000	50	3950	
Glass (Sorted by color)	9.	44	4.	16	6	10	.40
Mixed Glass Fines	9.	70	6.3	5	6	- 1	-0.06
Fourth Forest Pulp (4)	40. (Dry Basis)	45	18.	25	8	17	3.06
Newsprint (July 73) (4)			8	18	8	10	0.80
(Nov. 73) (4) Separated			8	35	8	27	2.16
(Jan. 74)			8	60	8	52	4.16
Paper (6)			15.			15	2.25
Energy Recovery							
Electric Energy (6)			6.67×10^4 Kwhr.			$.006/Kwhr.	4.00
Shredded Refuse Heat Value (7)			7.5×10^8 Btu/100 Ton			.50¢/M Btu	3.75
Total Combustible	75. (Wet Basis)	100	75.			(1.)	4.95
Combustible After							
Fiber Recovery	75. (Wet Basis)	66	50.			(2.)	3.3
Synthetic Fuel Oil (6)			4.80×10^8 Btu/Ton			.8-/10^6 Btu	3.36
Synthetic Fuel Gas (6)			6.7×10^8 Btu/Ton			.50/10^6 Btu	3.33
Steam			175	1.90 @ .95/1000#			3.33
			175				

1. Produces 450 Kilowatts-hours of Electricity/Ton, Valued at 1.1 Cent per Kilowatt-hours.
2. Producers 300 " " " " " " " " " " " "
3. From Madison Wisconsin Shredding and Landfill Operation.
4. Wall Street Journal - January 31, 1974
5. Transport Cost for 1973 Average Used Through-out, Value Fluctuates
6. Resource Recovery - The State of Technology, pg. 25
7. Commonwealth Edison 1974

This Table summarizes the by-product credits that may be realized by reclamation of recyclable materials from a ton of MSW. The credits reflect 1973 conditions and assume reasonable transportation charges to proximate recycling plants; i.e., the credits are based on delivered prices and representative concentrations of the salvaged materials in MSW. Extreme fluctuation can be seen in a one year period. Selection of appropriate value must be based on transport distance and market demand.

Table 10

TABLE OF RESOURCE RECOVERY VALUES FOR VARIOUS SYSTEMS

A. Small operation - magnetic separation of cans
$1.05/Ton of Input Municipal Solid Waste (M.S.W.)

B. Cans and Paper Recovered
$1.05 Cans
3.06 Paper - based on separate collection
$4.11/Ton of Input M.S.W.

C. Cans, Paper, Aluminum, Copper - Zinc Fraction Recovered
$1.05 Cans
3.06 Paper - separate collection
1.50 Aluminum
.95 Copper - Zinc Fraction
$6.56/Ton of Input M.S.W.

D. Cans, Paper, Aluminum, Copper-Zinc, and Fraction Heat Recovery
$1.05/T for Cans
3.06/T for Paper separate collection
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.00/T for Heat Recovery after Fiber Recovery
$9.56/Ton M.S.W. Input

E. Incineration with Residue Recovery. Recover only Steel Cans
$ .53 Cans from incinerator Residue

$ .53/Ton M.S.W

F. Metal Recovery, Heat Recovery, Heat Recovery of Shredded M.S.W.
$1.05/T for Magnetic can separation
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.75/T for Shredded Fuel Value

$7.25/T of Input M.S.W.

G. Incineration with Residue Recovery and Heat Recovery
$ .53/T for Cans from incinerator Residue
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
4.50/T for Heat Value

$8.00/T for Heat and Material Recovery of M.S.W.

H. Source separation and separate collection of newsprint
$ .80-4.16/Ton of Input Municipal Solid Waste (M.S.W.)

CAUTION: This table shows the value of recovered resources for 8 theoretical recovery systems. It is based on the "credit $/Ton" column of Table 9, and is subject to the conditions and assumptions stated. Tables 9 and 10 may need to be modified to reflect local markets and transportation costs.

Management Alternatives For Sangamon County

The Sangamon County Planning Commission has identified 2 major landfill sites within the county as being operational and having potential for use in this analysis. Forty-eight additional sites are listed for Sangamon County by the IEPA. These additional sites include: closed sites, promiscuous dumps, and potential future sites. The major facilities designated to be used in this system analysis include: the Airport Landfill and the Clay Products Landfill, having operating capacities of 2900 and 650 tons per week, respectively. These sites handle all the waste generated in the county plus some out-of-county wastes from the Jacksonville area. Food waste is excluded from the smaller site. The Airport Landfill operation could be enlarged by the addition of equipment and manpower so that the wastes from the entire county could be handled. The change to a single site could be accomplished now or upon the completion of the Clay Products site. Based on present waste loads and the estimated ultimate capacity of the Airport site, this landfill could provide the needed disposal capacity for as long as 15 years.

Present Problem

The wastes generated within a 30-mile radius is hauled to one of the two privately owned landfills by private collection trucks. Many of the collection vehicles are required to spend a considerable portion of their time in transit, thereby increasing the costs of the total service. The fact that Sangamon County has only two centrally located disposal sites is holding disposal costs at a reasonable level.

The major problems in the county are: (1) the high haul costs for the communities remote from Springfield; (2) the fact that the Clay Products Landfill will be completely filled in 1974 (see Table 4, Appendix A), and (3) the local concern for establishing a new landfill facility. The following analyses will consider several likely alter-

natives presently available to the county.

Computational Methods

Projections of the population and manufacturing employment were obtained from Argonne National Laboratory, checked by the county planners for reasonableness, and revised where necessary. Chapter I describes the method by which these projections were used for calculating waste loads. Tables 1, 2, and 3 of Appendix A contain the population projections, the employment projections and the estimated solid waste loads.

Geological Information

Appendix A summarizes the geological information for Sangamon County and indicates soil types and groundwater conditions as they pertain to sanitary landfill technology. This information is to be used as a general overview of the factors that must be investigated to provide adequate conditions for a landfill operation. Site-specific information is needed for a preliminary site evaluation and for the permit application to IEPA.

Short Term Analysis

The existing system is described by two diagrams (Alternative 1) which show waste sources, disposal sites, source-site pairings, and a cost summary. The unit cost of the system is $6.98/ton. The average unit cost for the disposal of all the county wastes is $1.85/ton as compared with the average unit hauling cost of $5.13/ton. The existing system is favored by the closure in recent years of several small, un-economical landfills. The large scale of operations at the Airport Landfill allows a very reasonable disposal cost of $1.63/ton. The most apparent deficiency in the existing hauling system is that many haulers do not go to the nearest landfill. There are practical reasons: (1) the Clay Products Landfill is limited by a municipal permit condition to the receipt of non-putrescible, demolition wastes; and (2) it is not likely that the owners will seek an unlimited

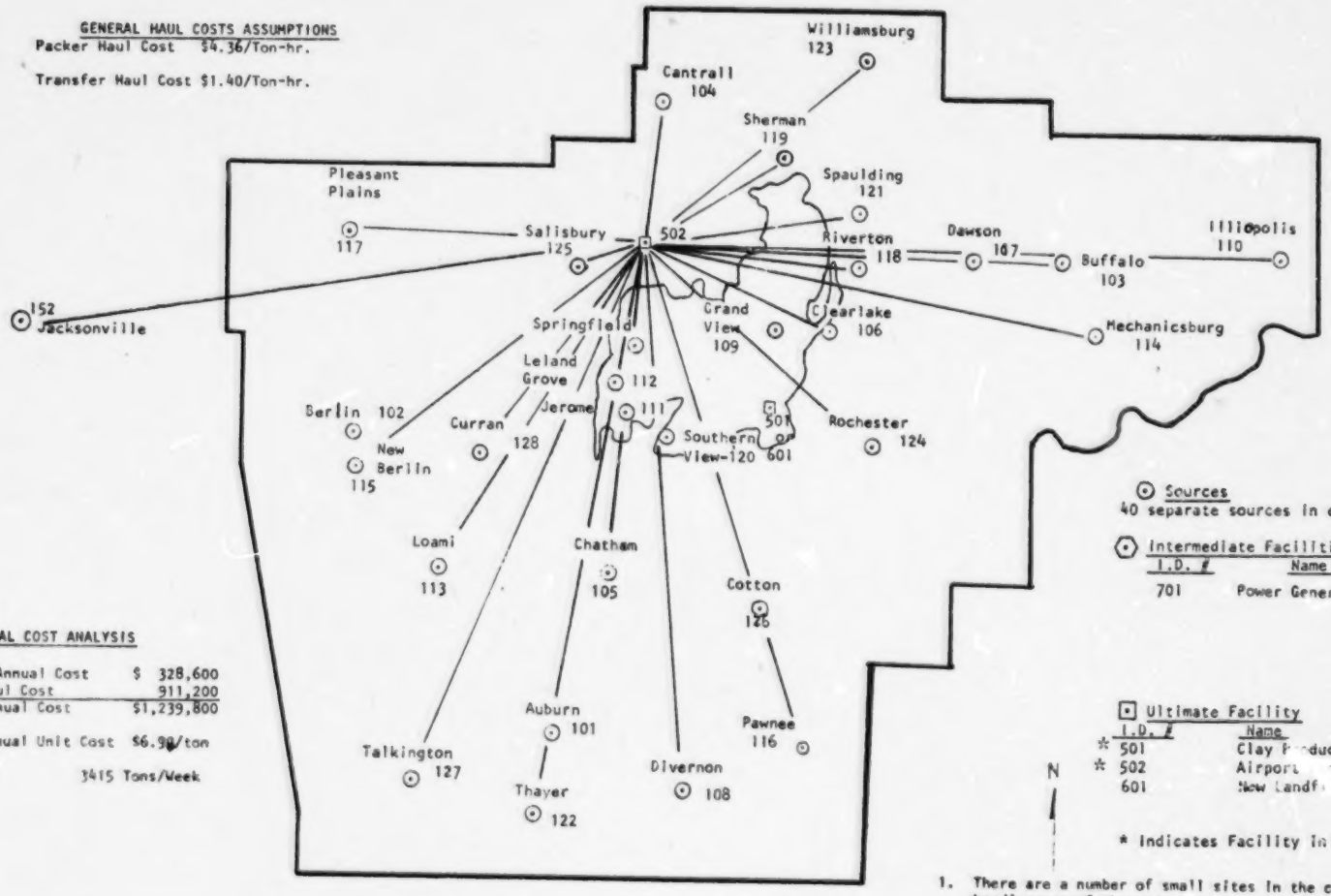
Sangamon County

Alternative 1 - Cost of the Existing System

GENERAL HAUL COSTS ASSUMPTIONS

Packer Haul Cost $4.36/Ton-hr.

Transfer Haul Cost $1.40/Ton-hr.



GENERAL COST ANALYSIS

Total Facility Annual Cost	$ 328,600
Total System Haul Cost	911,200
Total System Annual Cost	$1,239,800
Total System Annual Unit Cost	$6.90/ton
Tonnage Handled	3415 Tons/Week

⊙ Sources

40 separate sources in county

⬡ Intermediate Facilities

I.D. #	Name
701	Power Generating Station

⊡ Ultimate Facility

	I.D. #	Name
*	501	Clay Products Landfill
*	502	Airport Landfill
	601	New Landfill

* Indicates Facility In Use

This summary describes an evaluation of the present system. There are two (2) sites under consideration, the Airport Landfill and the Clay Products Landfill. These two fills are the recipients of all county generated wastes. Some sources are matched with sites by their proximity. The analysis emphasized the following facts:

1. There are a number of small sites in the county, but 2 major sites handle most of the waste.
2. The lifetime of the Clay Products landfill is short, but the Airport Landfill has a 15 plus year expectancy.
3. A number of haul distances are excessive, some haulers do not go to the closest site
4. The centroid of waste is found to be Springfield which is centrally located.
5. The largest landfill is capable of handling the entire waste of the county.
6. Waste from outside of the county is being handled.

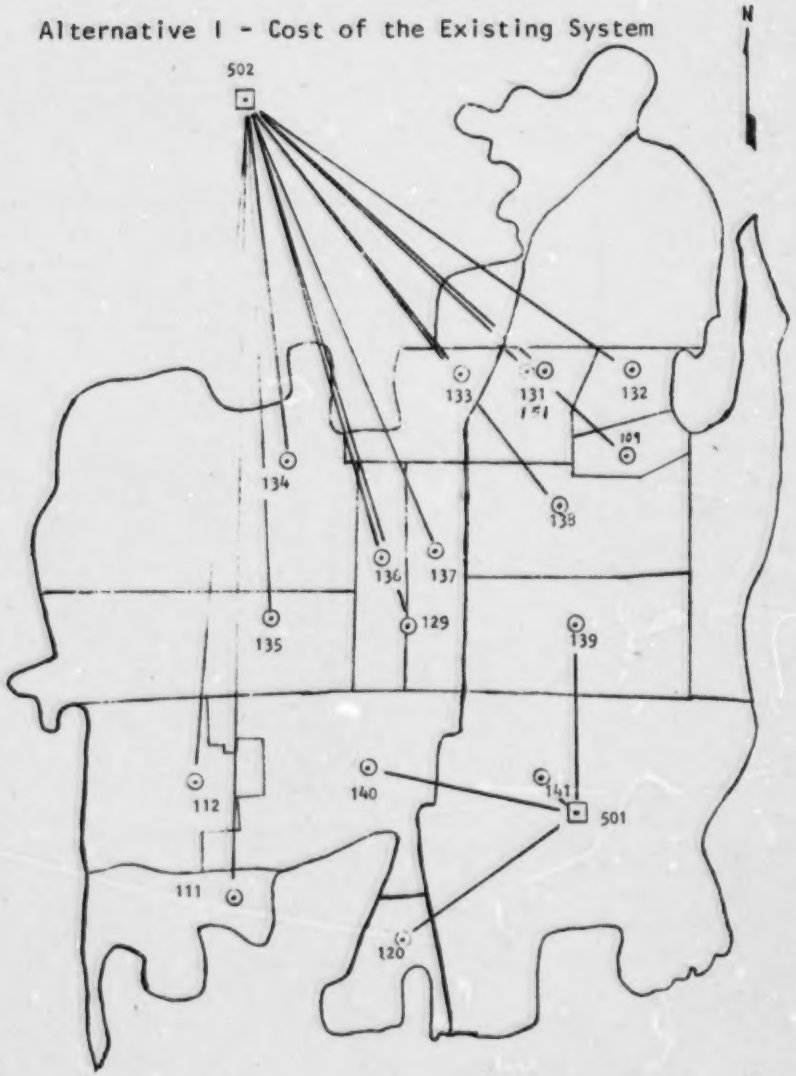
DIRECTIONS FOR FURTHER ANALYSIS:

1. Eliminate small landfill.
2. Use transfer stations to reduce land distance haul costs.
3. Consider the use of a processing facility.
4. Eliminate route crossing and optimize system.

Sangamon County

Springfield Specific

Alternative I - Cost of the Existing System



△ ⊙ Sources

I.D. #	Name
109	Grandview
111	Jerome
112	Leland Grove
120	Southern View
129	Main
131	North
132	North East
133	North West
134	West North
135	West South
136	West Center
137	East Center
138	East North
139	East South
140	South
141	South East

⬡ Intermediate Facilities

I.D. #	Name

⊡ Ultimate Facility

I.D. #	Name
* 501	Clay Products Landfill
* 502	Airport Landfill

* Indicates Facility In Use

permit since the facility will reach capacity in 1974. The Airport Landfill has more than 15 years capacity (at present levels) and could handle the entire county load.

When the Clay Products facility is closed, the savings in the facility cost will more than offset the savings in haul cost for the four sources now using the smaller landfill. The adjusted unit cost of $6.65/ton does not differ significantly from the regional system cost of $6.98/ton. This suggests that closing the Clay Products Landfill will not have a perceptible impact on the cost of solid waste management in Sangamon County.

It is conceivable that, in the short-term, the Clay Products Landfill could be expanded and licensed to take all municipal wastes. Alternative 2, therefore, considers the possibility of two unlimited landfills, the Airport landfill and a new facility located on a site near Clay Products. Results are summarized in the diagram. At $4.80/ton, this represents a considerable saving over the existing system (Alternative 1). The diseconomy of two landfills is more than offset by the saving in haul costs.

Long Term Analysis

The delay inherent in constructing a new system will vary from 2 years for a new landfill to a minimum of 5 years for a new processing facility.

Alternative 3 considers the possibility that an expansion of the regional airport might lead to the closing of the Airport Landfill. In this event, a single regional landfill located near the Clay Products Landfill would have the advantages of: (1) economy of operation, and (2) good regional access via I-55. The results of this alternative are summarized on the diagrams.

Sangamon County

Alternative 2 - Cost of Optimized Present System

Haul Cost Assumptions

Packer haul cost	$4.36/ton-hr.
Transfer haul cost	$1.40/ton-hr.

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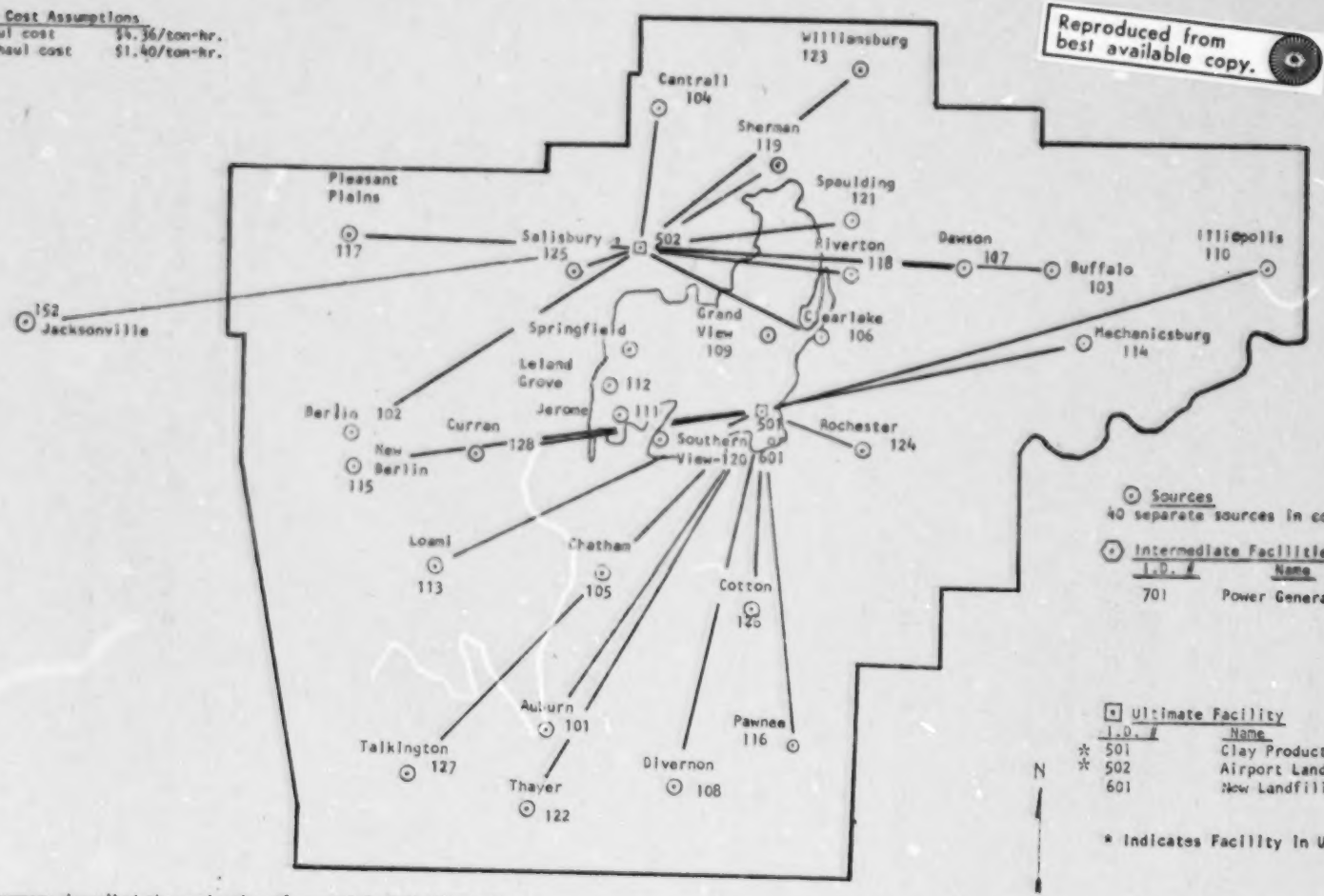


Sources
40 separate sources in county

Intermediate Facilities

I.D. #	Name
701	Power Generating Station

Ultimate Facility

	I.D. #	Name
*	501	Clay Products Landfill
*	502	Airport Landfill
	601	New Landfill

* Indicates Facility In Use

This summary described the evaluation of an optimized hauling system as can be seen, many of the source-site pairings have been changed and the Clay Products Landfill would be used much more extensively.

1. A lower system cost result from the optimization
2. Clay Products Landfill is more centrally located.
3. Lower cost for hauling from long distances can be seen.
4. The unit cost of operation for Clay Products Landfill lowers as the Airport values increase slightly.

The analysis emphasized the following facts:

Direction for further analysis:

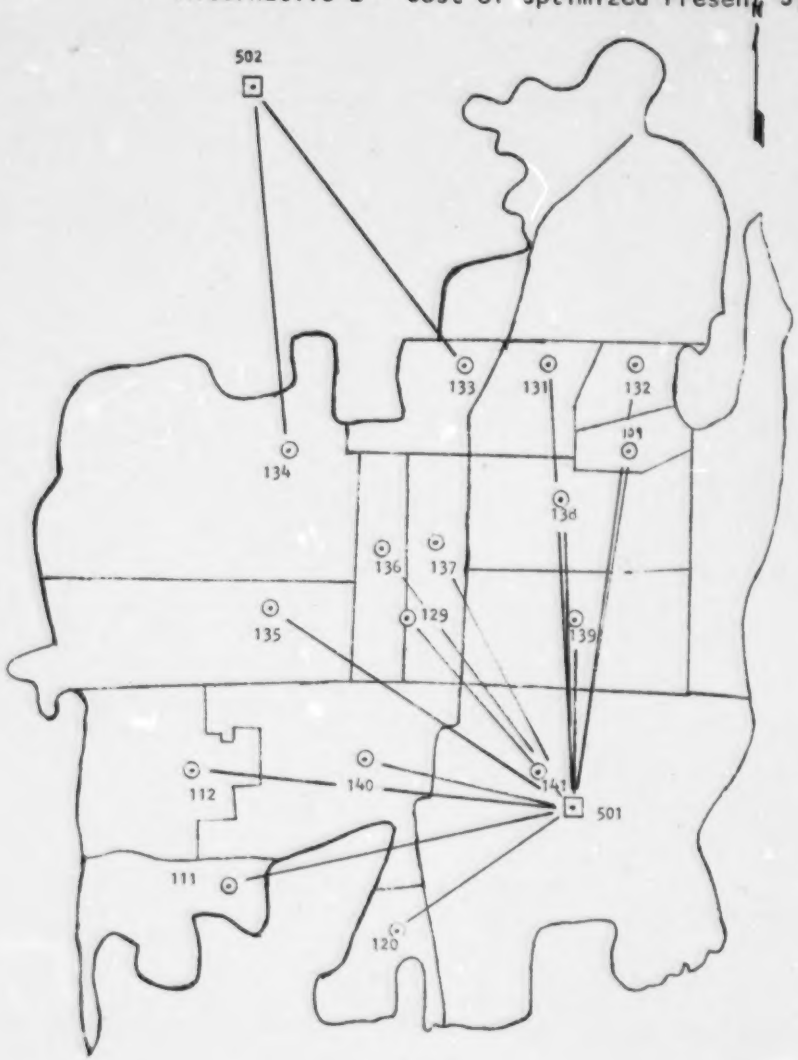
1. Add transfer stations at optimum locations
2. Consider resource recovery alternatives

General Cost Summary

Total Facility Annual Cost	$451,500
Total System Haul Cost	400,000
Total System Annual Cost	$851,500
Total System Annual Unit Cost	$4.80/ton
Tonnage Handled	3415 Tons/week

Springfield Specific

Alternative 2 - Cost of Optimized Present System



△ ⊙ Sources

I.D. #	Name
109	Grandview
111	Jerome
112	Leland Grove
120	Southern View
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131	North
132	North East
133	North West
134	West North
135	West South
136	West Center
137	East Center
138	East North
139	East South
140	South
141	South East

⬡ ⊙ Intermediate Facilities

I.D. #	Name

⊡ Ultimate Facility

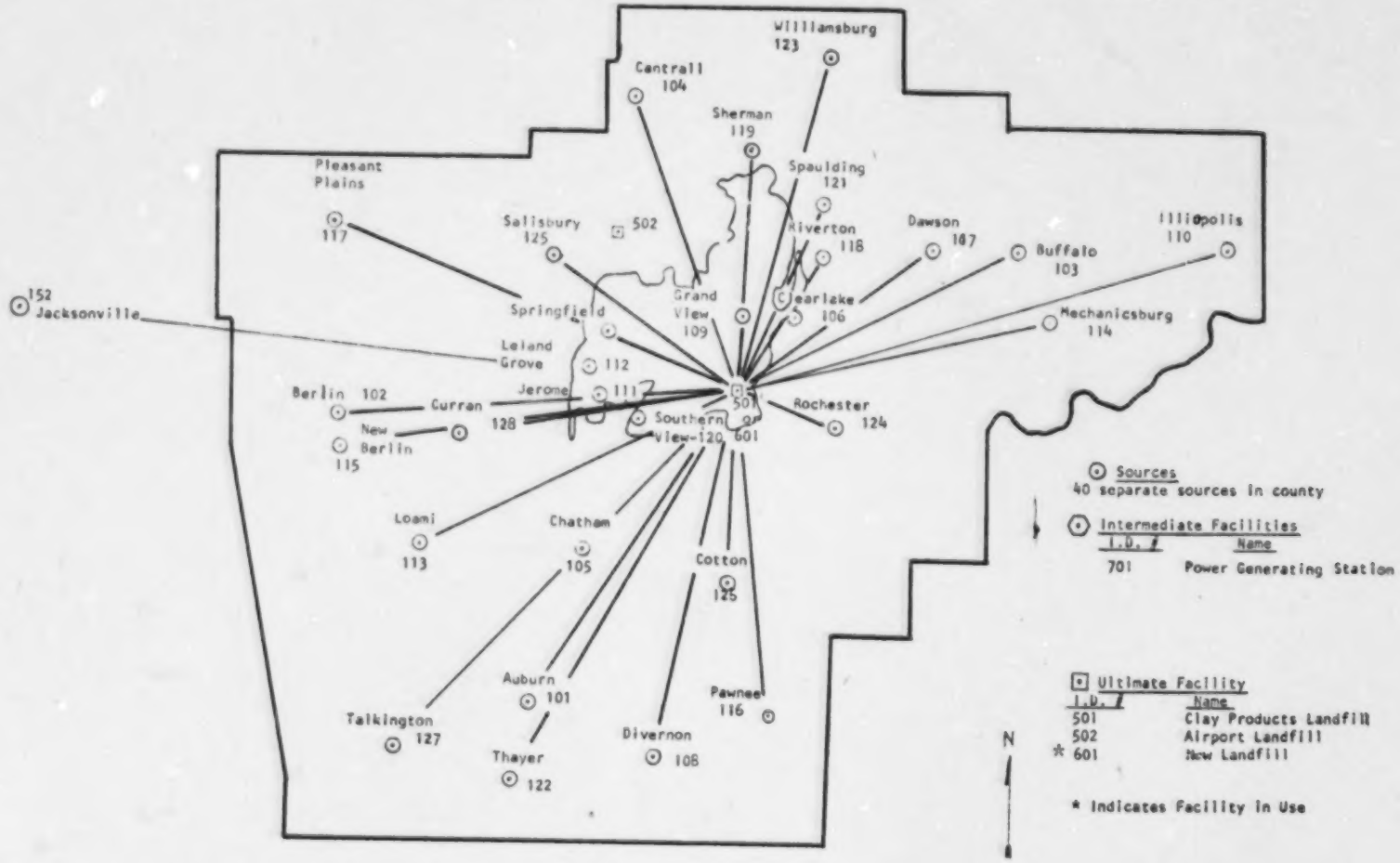
I.D. #	Name
*501	Clay Products Landfill
*502	Airport Landfill

* Indicates Facility in Use

Sangamon County

Alternative 3

A single Landfill Near The Present 501 Site (601) To Be Used For All County Wastes



General Haul Cost Assumptions

Packer Haul Cost	$4.36/Ton-hr.
Transfer Haul cost	1.40/Ton-hr.

General Cost Summary

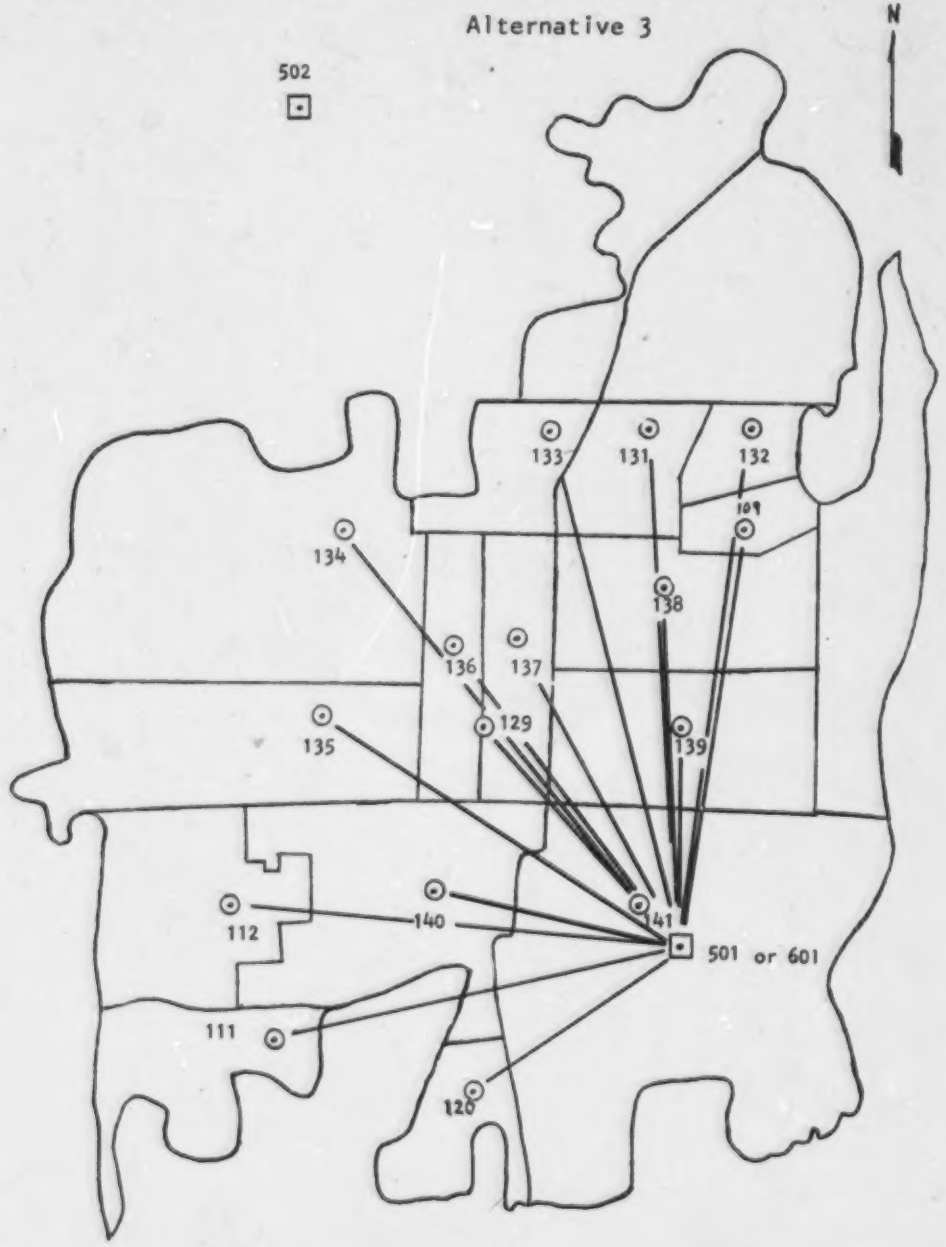
Total Facility Annual Cost	$291,000
Total System Haul Cost	1,054,000
Total System Annual Cost	$1,346,000
Total System Annual Unit Cost	$7.58/Ton
Tonnage Handled	3415 Tons Per Week

Sangamon County

Springfield Specific

A single Landfill Near The Present 501 Site (601) To Be Used For All County Wastes

Alternative 3



△ ⊙ Sources

I.D. #	Name
109	Grandview
111	Jerome
112	Leland Grove
120	Southern View
129	Main
131	North
132	North East
133	North West
134	West North
135	West South
136	West Center
137	East Center
138	East North
139	East South
140	South
141	South East

⊙ Intermediate Facilities

I.D. #	Name
701	Power Generating Station

⊡ Ultimate Facility

I.D. #	Name
501	Clay Products Landfill
502	Airport Landfill
* 601	New Landfill

* Indicates Facility In Use

The favorable facility cost inherent in a single landfill is offset by the increased haul expense. However, the system unit cost ($7.58/ton) is within 10 percent of the existing system cost and impact on regional solid waste management costs would not be great.

Not included in this estimate is the need for approximately 140 to 180 acres of land for the new site. Assuming a 40-foot depth of fill, this acreage would meet regional needs until 1991.

Alternative 4 considers the use of emerging technologies for resource recovery to offset landfill costs. The process which is best developed at this time (1974) and which requires an intermediate level of capital investment is the supplementary fuel system developed jointly by the City of St. Louis and the Union Electric Co. The facility could logically be built near the Municipal Power Plant. Waste would be shredded, metals, glass and inert materials removed and containerized for market and the shredded waste fed to the power plant boilers.

The haul cost to the resource recovery facility in 1974 would be approximately $1,054,500, or $5.90/ton. To this must be added the landfill cost of 15% for the input tonnage which would have no recovery value. This amounts to an estimated $1.00 per input ton.

According to estimates by the National Center for Resource Recovery and the U.S. Environmental Protection Agency, the shredding and recovery facility would cost approximately $2.6 million. The power plant installation would add another $1.7 million, for a total of $4.3 million. The total operating cost, including amortization, would be approximately $9.00/ton, for a total system cost of $15.90/ton.

To justify the added expense of a resource recovery system, some value must be placed on the secondary materials generated. It is estimated that 70% of the input waste will be combustible with a heat content of 5000 BTU/lb. The municipal utility is currently paying $.50/million BTU. At this rate, the shredded fuel would be worth $3.50/input ton. Table 10, Chapter 1 estimates the value of ferrous and non-ferrous metals and shredded fuel to be $7.25/ton.

Resource Heat Recovery System For 1973 Loading of Solid Waste

Alternative 4

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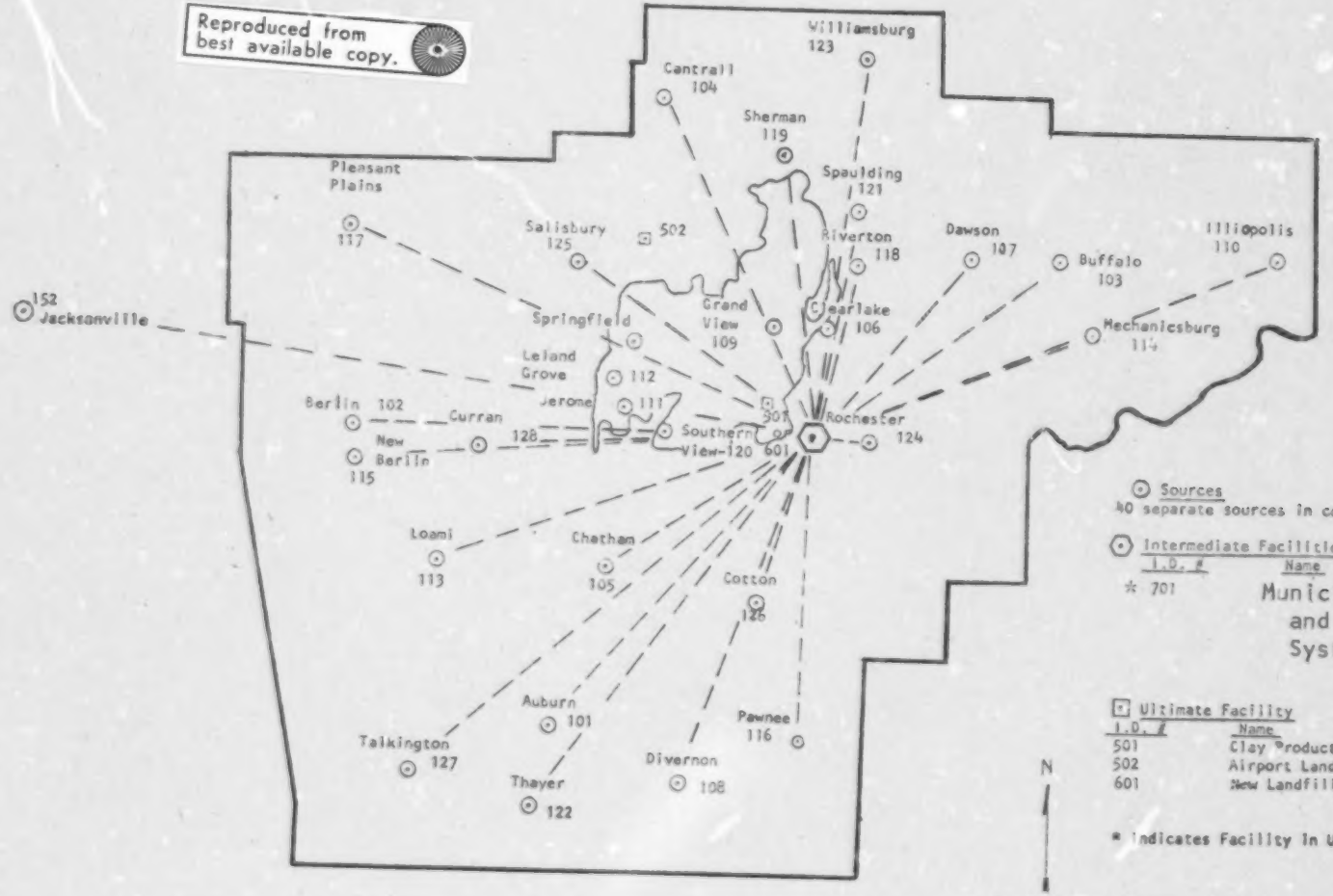


⊙ Sources
40 separate sources in county

⊙ Intermediate Facilities

I.D. #	Name
* 701	Municipal Power Plant and Resource Recovery System

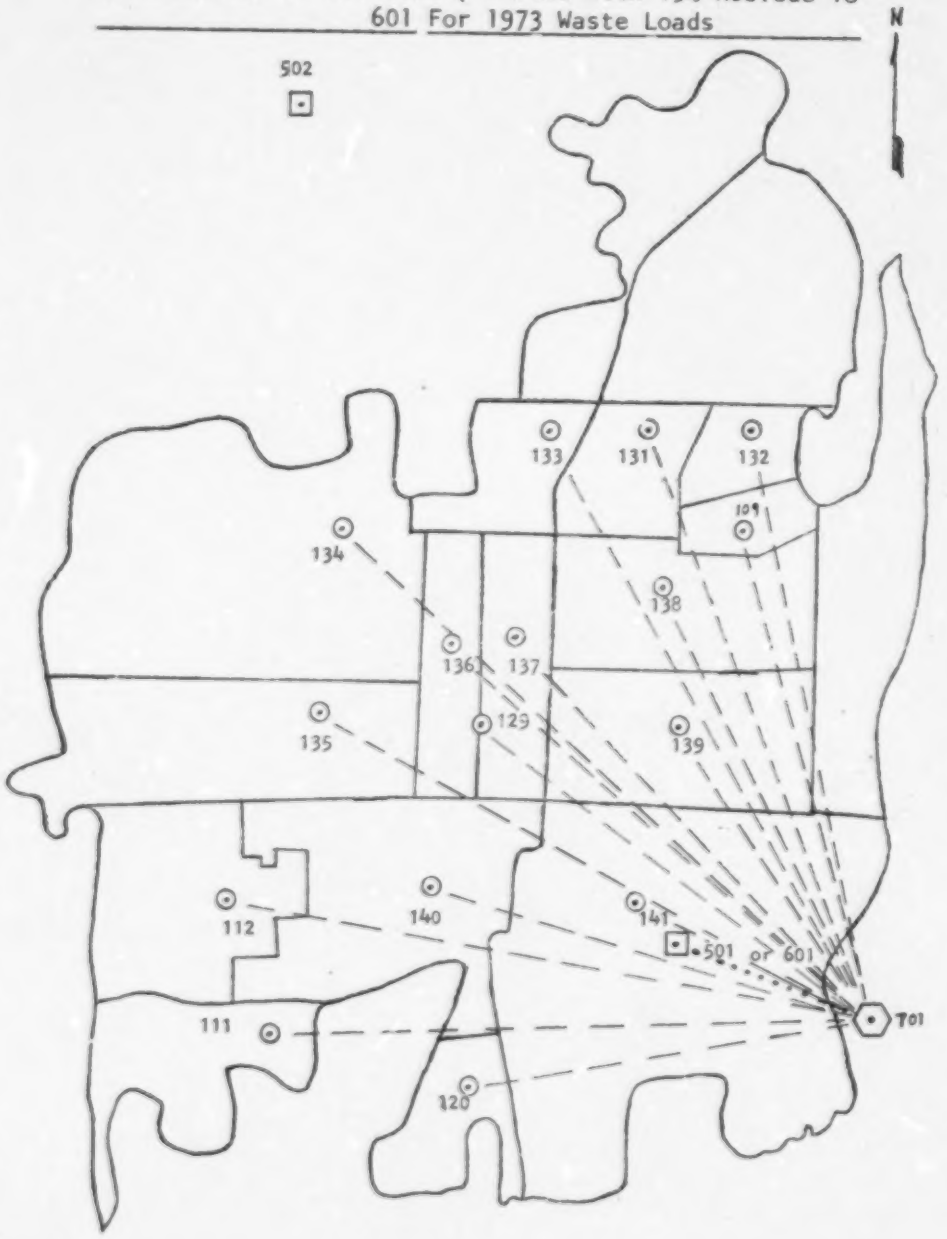
⊡ Ultimate Facility

I.D. #	Name
501	Clay Products Landfill
502	Airport Landfill
601	New Landfill

* Indicates Facility In Use

Residue Disposal Cost	180,000
Annual Facility Cost	1,590,000
Total System Haul Cost	1,054,500
Total System Cost	$2,824,500
System Unit Cost	$15.84/Ton

Springfield Specific
Sangamon County
Alternative 4
Incineration Of All County Wastes With 15% Residue To 601 For 1973 Waste Loads



△ ⊙ Sources

I.D. #	Name
109	Grandview
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112	Leland Grove
120	Southern View
129	Main
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133	North West
134	West North
135	West South
136	West Center
137	East Center
138	East North
139	East South
140	South
141	South East

⊙ Intermediate Facilities

I.D. #	Name
*701	Power Generating Station

⊡ Ultimate Facility

I.D. #	Name
501	Clay Products Landfill
502	Airport Landfill
* 601	New Landfill

* Indicates Facility In Use

At this level, the net system cost would be $8.65/input ton, an excessive cost when compared to the two-landfill alternative cost of $4.80/ton.

Two factors will tend to change the feasibility of this alternative: (1) increases in the quantity of solid waste handled will lower unit costs; and (2) the value of secondary materials may increase if materials specifications are established and industry changes over from the use of virgin raw materials.

Conclusions

The region will not have to make a decision until the Airport Landfill is completed in 1989, or until it is closed for other reasons. Any plan to close the Airport site should allow at least 2 years for opening a new site. Because of the high cost of hauling, the system unit cost can be reduced from $6.98/ton to $4.80/ton by opening a new landfill in the vicinity of the Clay Products site and by optimizing haul to the nearest facility. This two-landfill system for all county wastes was the least cost alternative examined in this study.

The resource recovery system does not appear to be justifiable at the current price levels for energy and recovered materials. As the price levels increase or specific local markets can be found for secondary materials and energy, a resource recovery plant may be completely justified. The logical place to put this facility is near the Municipal Power Plant, if power production is to be a part of this system. A new landfill near the present Clay Products site would save at present cost levels and would provide an ideal location for the resource recovery system when economics are more certain.

To Up-Date These Alternatives

This study is intended for elected officials, directors of public works, regional planners, and private solid waste operators - all of whom must work together to find acceptable solutions to regional waste problems. Much of this information presented here is subject to change. Planners and engineers who have need to up-date or modify these alternatives may obtain assistance from the Illinois Institute for Environmental Quality.

APPENDIX A

Sangamon County Information

1 Geological Information

2 Population Projections - Table A-1

3 Employment Projections - Table A-2

4 Total Solid Waste Quantities - Table A-3

5 Crisis and Decision Dates - Table A-4

SANGAMON

Type of Bedrock:	Mainly shale with some water-yielding sandstone and limestone
Drift Thickness:	Central and southwest - less than 50 ft., remainder - 50 up to 200 ft.
Type of Drift Mtl:	Till
Glacial Aquifers:	Possibly present
S & G Aquifers:	Eastern - scattered
Limestone Aquifers:	Absent
Sandstone Aquifers:	Possibly present

Sangamon county's bedrock consists of mainly non-permeable shale with some water-yielding sandstone and limestone. A buried valley cuts through the bedrock in the eastern part of the county. This valley was filled with glacial drift from 50 to 200 ft. deep and more, while the remainder of the county has drift from less than 50 ft. to less than 200 ft. deep. This drift consist of till and it has an 8 ft. layer of loess over it. Sand and gravel aquifers are found scattered in the eastern portion of the county, but they are rarely found elsewhere. Sandstone, but no limestone aquifers are located in the county.

Due to the thin drift in the central portion, the potential for contamination of the bedrock aquifers is moderate in this area. The potential for contamination of the unconsolidated layer aquifers is moderate around the periphery of the county. The combination of possible trouble areas account for the majority of the county.

TABLE A-1
PROJECTED POPULATION FOR
SANGAMON COUNTY

LOCATION INCORPORATED	1970*	1975	1980	1985	1990	1995	2000
AUBURN	2594	2560	2670	2850	3090	3190	3410
BERLIN	175	170	160	160	160	150	150
BUFFALO	462	410	420	430	450	450	470
CANTRALL	138	110	100	100	100	99	97
CHATHAM	2788	2540	2830	3210	3660	3960	4400
CLEARLAKE	228	220	230	240	250	260	270
DAWSON	427	410	410	430	450	460	480
DIVERNON	1010	970	970	990	1030	1020	1050
GRANDVIEW	2242	2700	2980	3350	3790	4080	4520
ILLIOPOLIS	1122	1170	1230	1340	1460	1530	1650
JEROME	1673	2010	2250	2550	2900	3140	3500
LELAND GROVE	1624	1540	1490	1480	1490	1440	1440
LOAMI	537	500	500	530	560	560	590
MECHANICSBURG	490	470	480	500	530	540	560
NEW BERLIN	754	710	730	770	820	840	890
PAWNEE	1936	1980	2150	2370	2650	2820	3090
PLEASANT PLAINS	644	600	620	660	700	720	760
RIVERTON	2090	1990	2080	2230	2420	2510	2690
ROCHESTER	1667	1580	1770	2010	2300	2490	2780
SHERMAN	327	370	430	500	590	650	730
SOUTHERN VIEW	1504	1800	1990	2230	2530	2720	3010
SPAULDING	220	190	190	200	210	210	210
SPRINGFIELD	91753	91300	93800	98900	105000	108000	114000
THAYER	616	570	540	540	540	510	510
WILLIAMSVILLE	923	900	940	1010	1110	1150	1240
SUB TOTAL	117944	117000	122000	129000	139000	143000	153000
UNINCORPORATED	43391	48400	51700	56400	62400	65700	71400
COUNTY TOTAL**	161335	166000	173000	186000	202000	209000	224000

GROWTH OF GRAND VIEW, JEROME, LELAND GROVE AND SOUTHERN VIEW REFLECTS INCREASES IN SPRINGFIELD'S POPULATION.

* CENSUS DATA REPORT PC(V1)-15 JANUARY 1971
** SUMMATIONS PERFORMED PRIOR TO ROUNDING OFF

TABLE A-2

PROJECTED EMPLOYMENT FOR

SANGAMON COUNTY

COUNTY TOTALS

SIC	1971	1975	1980	1985	1990	1995	2000
201	117	97	79	63	51	41	33
202*	64	57	51	45	40	36	31
203	5	6	6	6	5	5	5
204	932	850	780	710	650	590	540
205	314	330	340	350	370	380	390
207	8	9	10	11	12	13	13
208	137	120	110	100	100	92	85
209	94	70	51	37	27	19	14
239	41	35	23	15	10	6	4
243*	332	350	370	390	420	440	460
244	6	7	5	3	3	3	2
251	181	160	150	140	130	120	110
253	22	23	23	24	24	24	24
254	2	3	3	3	2	2	2
259	2	1	0	0	0	0	0
273	50	59	71	83	94	100	110
275	643	660	690	710	730	750	770
279	46	47	47	46	46	46	45
281*	109	110	85	62	45	33	24
282	146	170	200	220	250	270	290
284	1	1	0	0	0	0	0
285	50	53	55	57	59	61	63
287	22	42	63	83	100	120	140
306	8	9	9	8	8	8	8
307	81	73	65	59	52	46	41
325	105	100	100	93	87	80	74
3272	8	12	17	21	26	30	34
327*	196	190	200	220	230	250	260
331*	19	20	20	19	19	19	19
336	6	7	7	7	7	6	6
339	2	3	3	2	2	2	2
344	266	340	430	520	610	700	780
345	3	4	2	1	1	0	0
352	3928	4020	3980	3910	3840	3760	3670
353	29	36	45	54	62	71	79
354	18	19	19	18	18	18	18
357	2	3	3	3	3	2	2
358	49	50	50	49	49	49	48
361	2599	2400	2230	2070	1910	1760	1610
362	56	71	86	100	110	120	140
363	199	320	470	620	770	920	1060
367	98	160	250	350	440	520	610
369	29	31	37	42	48	53	58
371	964	1030	1100	1160	1220	1270	1320
382	16	17	17	16	16	16	16
399	37	37	38	40	41	42	43

TABLE A-2 CONTINUED

INDIVIDUAL CITY EMPLOYMENT

AUBURN

SIC	1971	1975	1980	1985	1990	1995	2000
275	8	8	10	10	11	13	14

CHATHAM

SIC	1971	1975	1980	1985	1990	1995	2000
243*	25	25	25	25	26	27	27
367	70	130	210	300	380	450	530

ILLIOPOLIS

SIC	1971	1975	1980	1985	1990	1995	2000
239	3	2	2	2	2	2	1
273	3	3	3	3	3	3	3
281*	85	87	64	42	28	18	11
282	147	170	200	220	240	260	280
287	9	13	16	14	12	9	10
3272	9	11	17	20	26	30	33
352	9	9	9	9	9	9	8

Table A-2 CONTINUED

PAWNEE

SIC	1971	1975	1980	1985	1990	1995	2000
287	1	0	0	0	0	0	0

RIVERTON

SIC	1971	1975	1980	1985	1990	1995	2000
307	2	0	0	0	0	0	0
353	3	3	3	3	3	4	4

ROCHESTER

SIC	1971	1975	1980	1985	1990	1995	2000
287	6	15	28	43	55	73	92
353	1	0	0	0	0	0	0

Table A-2 CONTINUED

SPRINGFIELD

SIC	1971	1975	1980	1985	1990	1995	2000
201	118	97	78	63	50	41	33
202*	65	56	51	44	40	35	30
203	6	6	6	6	5	5	5
204	927	850	770	700	640	580	530
205	315	320	340	350	360	380	380
207	9	9	9	10	11	12	13
208	138	110	110	99	100	91	84
209	95	69	50	37	26	19	14
239	39	32	20	11	7	4	2
243*	308	320	340	360	390	410	430
244	7	6	5	4	3	2	1
251	182	150	140	130	130	110	100
253	23	0	0	0	0	0	0
254	3	3	3	3	2	2	2
259	3	0	0	0	0	0	0
273	48	55	67	79	90	96	100
275	636	650	670	690	710	730	750
279	47	47	47	46	45	45	44
281*	25	22	21	19	16	14	12
284	2	1	0	0	0	0	0
285	51	52	54	56	59	61	63
306	9	9	9	8	8	8	8
307	80	72	65	59	51	46	40
325	106	99	100	92	86	79	74
327*	197	190	200	220	230	250	260
331*	20	20	20	19	19	19	19
336	7	7	7	7	7	6	6
339	3	3	3	2	2	2	2
344	267	330	420	520	610	690	770
345	4	3	2	1	0	0	0
352	3920	4010	3970	3900	3830	3750	3660
353	26	31	41	50	57	67	74
354	19	19	19	18	18	18	18
357	3	3	3	3	3	2	2
358	50	50	50	49	48	48	47
361	2600	2400	2230	2070	1910	1760	1610
362	57	71	86	99	100	120	140
363	200	310	470	610	770	910	1060
367	29	26	36	47	56	63	73
369	30	30	37	42	47	53	58
371	965	1030	1909	1160	1210	1270	1320
382	17	17	17	16	16	16	16
399	38	37	37	40	40	42	43

Table A-3

STUDY PERIOD SOURCE INVENTORY

Sangamon County

Source Name	Source I.D.#	1973 Waste Quantity (Tons/Week)	1990 Waste Quantity (Tons/Week)	Source Name	Source I.D.#	1973 Waste Quantity (Tons/Week)	1990 Waste Quantity (Tons/Week)
Auburn	101	65	132	Thayer	122	9	12
Berlin	102	38	83	Williamsville	123	36	233
Buffalo	103	7	11	Rochester	124	61	147
Central	104	2	2	Salisbury	125	31	69
Chatham	105	69	152	Cotton	126	39	94
Clearlake	106	3	6	Talkingtown	127	23	50
Dawson	107	30	69	Curran	128	22	49
Divernon	108	32	62	Spring Main	129	74	75
Grandview	109	40	111	Spring N.	131	161	265
Illiopolis	110	145	261	Spring N.E.	132	182	265
Jerome	111	29	83	Spring, N.W.	133	182	265
Leland Grove	112	25	39	Spring, W.N.	134	182	265
Loami	113	32	68	Spring, W.S.	135	182	265
Mechanicsburg	114	39	84	Spring, W.C.	136	182	265
New Berlin	115	10	18	Spring, E.S.	137	182	265
Pawnee	116	48	105	Spring, E.N.	138	182	265
Pleasant Plains	117	52	112	Spring, E.S.	139	182	265
Riverton	118	51	105	Spring, S.	140	178	265
Sherman	119	25	64	Spring, S.E.	141	181	265
Southern View	120	27	21	Spring, N.E.S.	151	20	20
Spaulding	121	3	5	Jacksonville	152	352	352
				Total		3415	5609

Table A-4

Crisis and Decision Dates

Alternative #1: All fills will be used for disposal from present waste sources and go to completion. New fill or processing facilities will receive the waste as the present sites close. Two years lead time must be allowed for a new facility.

Facility I.D. #	501	502
Crisis Date	1974	1988
Decision Date	Now	1986

Alternative #2: The optimized system assumes that a new fill site (601) will be found in the area of the present 501 site. The new site would have 1.9×10^6 tons @500#/yd^3 ultimate capacity based on data from the planning agency.

Facility I.D. #	601	502
Crisis Date	1984	1992
Decision Date	1982	1990

Alternative #3: This alternative is predicated on the assumption that the new landfill (601) near the present Clay Products site will be used exclusively. The dates are based on a 1978 average waste load (3854 ton/week).

Facility I.D. #	601
Crisis Date	1982
Decision Date	1980

Table A-4

(continued)

Alternative #4: Uses a shredding plant to produce fuel for the municipal power plant. The 15% residue will go to the new site 601. All material will go to 601 for 5 years to allow for construction of a 20-year lifetime incinerator.

Facility I.D. #	601
Crisis Date	1992
Decision Date	1990

APPENDIX B

	Pages
1. Method for calculating municipal and industrial collection rates.	B-1
2. Industrial waste generation factors. Table B-1	B-3
3. Haul Cost Factor with assumptions. Table B-2	B-6
4. Cost Functions: Sanitary Landfill. Figure B-1	B-9
5. Basic Landfill Cost Assumptions For 50, 100, 250, 500, 1000, 2000, and 5000 tons/week. Tables B-3 to B-9	B-10
6. Cost Functions: Intermediate Processing Facilities. Figure B-2	B-18
7. Equations for Facility Cost Functions.	B-19
8. Resource Recovery Facility Description.	B-21
9. Resource Recovery Capital and Annual Cost. Table B-10	B-22

Municipal Generation Rates

The technique selected for estimating present generation rates was developed by Roy F. Weston, Inc. The technique involved the calculation of a generation rate factor which was then multiplied by the population to obtain the generation rate per week for a given geographic area. The generation factor is a function of the population density as shown in the following equations:

$$U = 1.54 \text{ Log } D - 0.68$$

$$V = U \times 7 \text{ day/week} \times 1 \text{ ton/2000 lbs.}$$

$$W = V \times \text{Population within the given area}$$

where: U = per capita waste generation rate in lbs/capita /day

D = population density in person/square miles

V = per capita waste generation rate in tons/capita/week

W = ton per week of waste generated within given area

This relationship is valid in the population density range of 500 - 12,000 persons/square mile. Below the lower limit of the range, the generation factor used is 3.4 lbs/capita/day; above the upper limit, the factor used is 5.6 lbs/capita/day.

Industrial Generation Rate

During the past few years, the Office of Solid Waste Management Programs has funded a number of industrial solid waste surveys to develop solid waste generation factors. A summary of these factors was used to develop industrial solid waste loads by SIC number. The following equation demonstrates the use of the generation factors.

$$I = G.F. \times \text{No. of Employees}$$

$$J = I \div 52$$

where I = yearly production rate in tons/year

G. F = generation factor in tons/employee/year

J = weekly production rate in tons/week

These relationships are used to estimate probable industrial waste loads, but the yearly employment fluctuation, and generation factors make adjustment necessary for specific locations and plants.

TABLE B-1

Industrial Solid Waste Generation Factors [8]

SIC No.	Name	Generation Factor (tons/employee/year)
201	Meat Products	14.1
2021	Creamery butter	33.0
2022	Cheese, Natural and Processed	169.1
202 (R)[1]	Dairy Products	2.2
203	Canned and Preserved Fruits, Vegetables and Sea Foods	5.4
204	Grain Mill Products	6.2
205	Bakery Products	1.2
206	Sugar	17.2
207	Confectionery and Related Products	3.3
208	Beverages	11.0
209	Miscellaneous Food Preparations and Kindred Products	0.8
211	Cigarettes	1.5
212	Cigars	3.1
213	Tobacco (Chewing and Smoking) and Snuff	0.2
214	Tobacco Stemming and Redrying	4.4
221	Broad Woven Fabric Mills, Cotton	0.4
222	Broad Woven Fabric Mills, Man-made Fiber and Silk	0.7
223	Broad Woven Fabric Mills	0.1
224	Narrow Fabrics and Other Small-wares Mills: Cotton, Wool, Silk and Man-made Fiber	1.2
225	Knitting Mills	1.3
226	Dyeing and Finishing Textiles, Except Wood Fabrics and Knit Goods	2.4
227	Floor Covering Mills	0.2
228	Yarn and Thread Mills	0.7
229	Miscellaneous Textile Goods	4.5
231	Men's, Youths', and Boys' Suits, Coats and Overcoats	0.3
232	Men's, Youths', and Boys' Furnishings, Work Clothing, and Allied Garments	0.3
233	Women's, Misses', and Juniors' Outerwear	0.9
234	Women's, Misses', Children's and Infants' Under Garments	0.4
235	Hats, Caps, and Millinery	0.2
236	Girls', Children's, and Infants' Outerwear	0.9
237	Fur Goods	0.5
238	Miscellaneous Apparel and Accessories	0.4
239	Miscellaneous-Fabricated Textile Products	0.4
241	Logging Camps and Logging Contractors	30.0
2421	Sawmills and planing mills, general	420.0
242 (R)[1]	Sawmills and planing mills	38.7
2432	Veneer and plywood	232.0
243 (R)[1]	Millwork, Veneer, Plywood, and Prefabricated Structural Wood Products	21.7
244	Wooden Containers	16.0
249	Miscellaneous Wood Products	43.0
251	Household Furniture	1.8
252	Office Furniture	2.6
253	Public Building and Related Furniture	1.8
254	Partitions, Shelving, Lockers, and Office and Store Fixtures	3.6
259	Miscellaneous Furniture and Fixtures	1.5
261	Pulp Mills	31.5
262	Paper Mills, Except Building Paper Mills	11.7
263	Paperboard Mills	11.5
264	Converted Paper and Paperboard Products, Except Containers and Boxes	4.0
265	Paperboard Containers and Boxes	12.6
266	Building Paper and Building Board Mills	103.0
271	Newspapers: Publishing, Publishing and Printing	1.1
272	Periodicals: Publishing, Publishing and Printing	0.1
273	Books	0.8
274	Miscellaneous Publishing	0.1
275	Commercial Printing	1.1
276	Manifold Business Forms	4.4
277	Greeting Card Publishing	1.2
278	Blankbooks, Loose Leaf Binders, and Bookbinding and Related Work	2.6
279	Service Industries for Printing Trade	1.4
2819	Industrial Inorganic Chemicals, not Elsewhere Classified	109.0
281 (R)[1]	Industrial Inorganic and Organic Chemicals	18.8
282	Plastics Materials and Synthetic Resins, Synthetic Rubber, Synthetic and Other Man-Made Fibers, Except Glass	16.2

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
283	Drugs	3.4
284	Soap, Detergents, and Cleaning Preparations, Perfumes, Cosmetics, and Other Toilet Preparations	3.3
285	Paints, Varnishes, Lacquers, Enamels, and Allied Products	6.2
286	Gum and Wood Chemicals	0.1
287	Agricultural Chemicals	13.5
2891	Adhesives and gelatin	39.4
289 (R)[1]	Miscellaneous Chemical Products	1.2
291	Petroleum Refining	30.6
295	Paving and Roofing Materials	0.9
299	Miscellaneous Products of Petroleum and Coal	9.3
301	Tires and Inner Tubes	3.7
302	Rubber Footwear	2.1
303	Reclaimed Rubber	2.4
306	Fabricated Rubber Products, Not Classified Elsewhere	2.5
307	Miscellaneous Plastics Products	1.3
311	Leather Tanning and Finishing	2.3
312	Industrial Leather Belting and Packing	0.8
313	Boot and Shoe Cut Stock and Findings	1.8
314	Footwear, Except Rubber	0.4
315	Leather Gloves and Mittens	1.3
316	Luggage	7.0
317	Handbags and Other Personal Leather Goods	0.4
319	Leather Goods, Not Elsewhere Classified	0.5
321	Flat Glass	2.5
322	Glass and Glassware, Pressed or Blown	1.4
323	Glass Products, Made of Purchased Glass	1.8
324	Cement, Hydraulic	8.8
325	Structural Clay Products	1.7
326	Pottery and Related Products	3.6
3272	Concrete products, except block and brick	154.0
327 (R)[1]	Concrete, Gypsum, and Plaster Products	15.0
328	Cut Stone and Stone Products	4.2
329	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products	5.2
3312	Blast Furnaces (including coke ovens), Steel Works, and Rolling Mills	130.0
331 (R)[1]	Blast furnaces, Steel Works, and Rolling and Finishing Mills	3.4
3321	Gray Iron foundries	100.0
332 (R)[1]	Iron and Steel Foundries	20.0
3334	Primary production of aluminum	58.0
333 (R)[1]	Primary Smelting and Refining of Nonferrous Metals	2.5
334	Secondary Smelting and Refining of Nonferrous Metals	103.0
335	Rolling, Drawing and Extruding of Nonferrous Metals	5.3
336	Nonferrous Foundries	2.7
339	Miscellaneous Primary Metal Products	2.0
341	Metal Cans	11.2
342	Cutlery, Hand Tools, and General Hardware	2.8
343	Heating Apparatus (Except Electric) and Plumbing Fixtures	7.3
344	Fabricated Structural Metal Products	2.8
345	Screw Machine Products, and Bolts, Nuts, Screws, Rivets and Washers	2.9
346	Metal Stampings	6.2
347	Coating, Engraving and Allied Services	1.5
348	Miscellaneous Fabricated Wire Products	3.1
3491	Metal Shipping Barrels, Drums, Kegs and Nails	13.7
349	Miscellaneous Fabricated Metal Products	1.4
351	Engines and Turbines	1.5
352	Farm Machinery and Equipment	0.9
353	Construction, Mining, and Materials Handling Machinery and Equipment	2.2
354	Metalworking Machinery and Equipment	2.9
355	Special Industry Machinery, Except Metalworking Machinery	0.7
356	General Industrial Machinery and Equipment	1.3
357	Office, Computing, and Accounting Machines	0.8
358	Service Industry Machines	1.5
359	Miscellaneous Machinery, Except Electrical	1.4
361	Electric Transmission and Distribution Equipment	0.8
362	Electrical Industrial Apparatus	0.7
363	Household Appliances	2.4
364	Electric Lighting and Wiring Equipment	2.2
365	Radio and Television Receiving Sets, Except Communication Types	0.8

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
366	Communication Equipment	1.9
367	Electronic Components and Accessories	1.0
369	Miscellaneous Electrical Machinery Equipment, and Supplies	2.8
371	Motor Vehicles and Motor Vehicle Equipment	2.4
372	Aircraft and Parts	1.2
3731	Ship Building and Repairing	37.0
3732	Boat Building and Repairing	4.1
374	Railroad Equipment	6.2
375	Motorcycles, Bicycles, and Parts	2.9
379	Miscellaneous Transportation Equipment	1.7
381	Engineering, Laboratory, and Scientific and Research Instruments and Associated Equipment	1.1
382	Instruments for Measuring, Controlling, and Indicating Physical Characteristics	0.4
383	Optical Instruments and Lenses	0.5
384	Surgical, Medical, and Dental Instruments and Supplies	2.3
385	Ophthalmic Goods	2.6
386	Photographic Equipment and Supplies	0.4
387	Watches, Clocks, Clockwork Operated Devices, and Parts	0.6
391	Jewelry, Silverware, and Plated Ware	0.8
393	Musical Instruments	0.6
394	Toys, Amusement, Sporting and Athletic Goods	1.7
395	Pens, Pencils, and Other Office and Artists' Materials	0.5
396	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal	0.3
399	Miscellaneous Manufacturing Industries	2.0

1) Includes the waste in the remainder of the 4-digit codes under this 3-digit code.

TABLE B-2

HAUL COST FACTORS

Type of Truck	Capacity, yd^3	Compacted Density lbs/yd^3	Cost of Truck($)	Life of Truck(yr)	Daily Operating Cost ($)	No. in Crew		Wages, $/hr.(3)				Work-Day (Hrs.)	Work-Week (Days)	Haul Cost($/ton-hr.)	
								Chicago		Downstate					
						Driver	Laborer	Driver	Laborer	Driver	Laborer			Chicago	Downstate
Rear Loading Compactor	16	500	17,175	5	40	1	1	7.19	6.56	5.70	5.10	8	5	5.10	4.36
Rear Loading Compactor (Municipal	25	500	20,772	5	35	1	2	7.19	6.56	5.70	5.10	8	5	4.28	3.66
Rear Loading Compactor (Private)	25	800	30,444	5	35	1	2	7.19	6.56	5.70	5.10	8	5	2.76	2.32
Front Loading Compactor	30	800	42,875	5	40	1	0	7.19	-	5.70	-	8	5	1.35	1.23
Tilt Frame & 13 Containers	42	500	42,325(1)	5	35	1	0	7.19	-	5.70	-	8	5	1.98	1.75
Tractor & 2 Transfer Trailers	75	500	75,800(2)	5	52	1	0	7.19	-	5.70	-	8	6	1.10	1.00*

(1) Includes the cost of the 13 containers.
(2) Includes the cost of the 2 transfer trailers.
(3) Includes fringe benefits.
* $1.40/Ton-Hr. For Vehicles operated 6 hours per day

ASSUMPTIONS FOR HAUL COST CALCULATIONS

Chicago Area

Assumptions:

1. 45% residential, 30% industrial, & 25% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 24 yd^3 compactor trucks used for residential collection.
5. Tilt-frame trucks used for industrial collection.
6. 30 yd^3 front loading compactor trucks used for commercial collection.
7. 5 loads/day by tilt-frame trucks.
8. 3 loads/day by front loading compactor trucks.

Haul Costs:

1. From collection route to intermediate facility or disposal site, collection vehicles operate 8 hours per day.
2. From intermediate facility to disposal site, vehicles operate 8 hours per day - $1.10/ton-hr.

Downstate

Assumptions:

1. 75% residential, 15% industrial, and 10% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 25 yd^3 compactor trucks used for residential collection.

5. Tilt-frame trucks used for industrial collection.

6. 30 yd^3 front loading compactor trucks used for commercial collection.

7. 5 loads/day by tilt-frame trucks.

8. 3 loads/day by front loading compactor trucks.

Haul Costs:

1. From collection route to intermediate facility or disposal site, collection trucks operate 8 hours per day.

2. From intermediate facility to disposal site where total loads are less than 150 tons/day, vehicles operate 6 hours per day - $1.40/ton-hr. For total loads greater than 150 ton/day, vehicles operate 8 hours per day - $1.00/ton-hr.

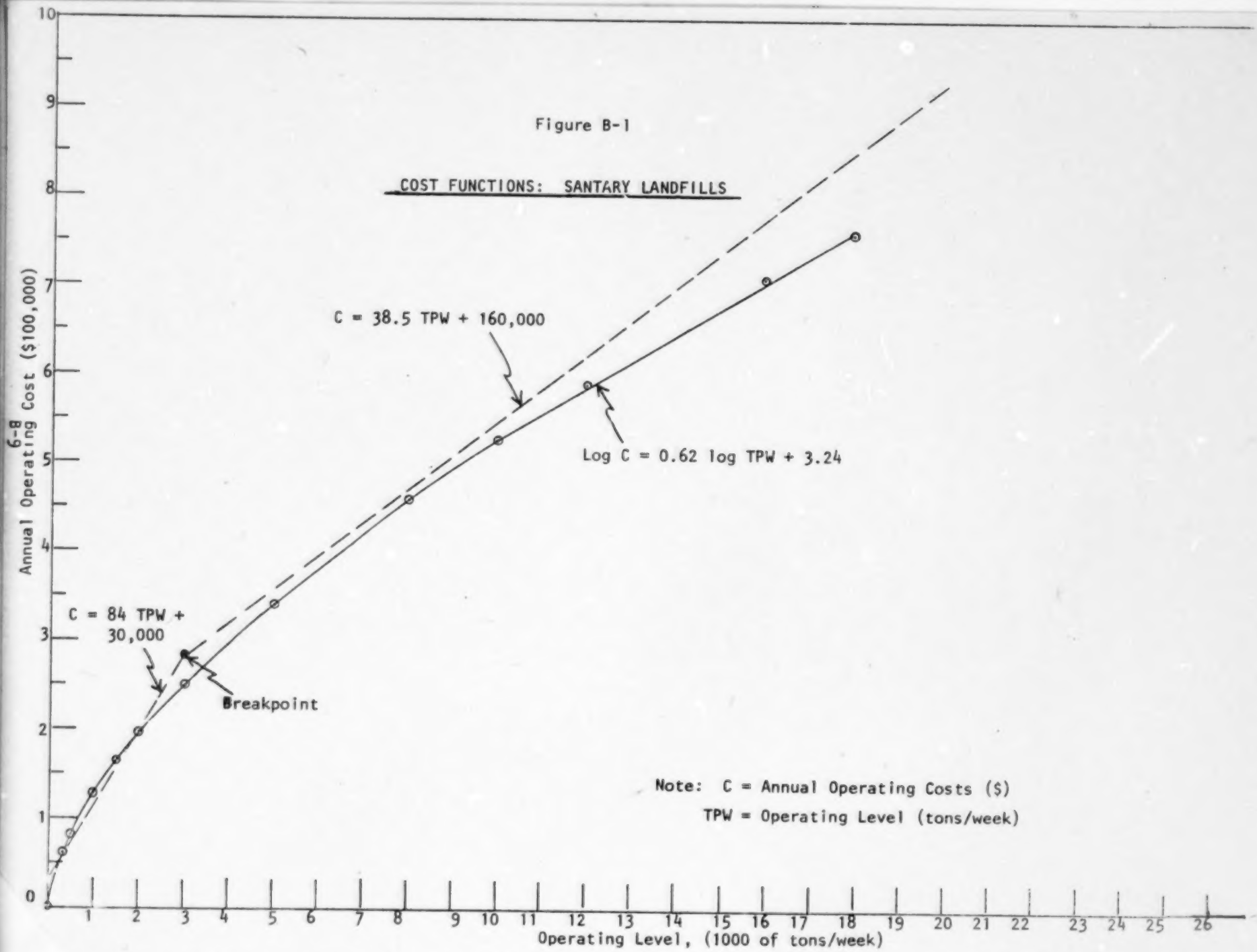


Figure B-1
COST FUNCTIONS: SANTARY LANDFILLS
C = 38.5 TPW + 160,000
Log C = 0.62 log TPW + 3.24
C = 84 TPW + 30,000
Breakpoint
Note: C = Annual Operating Costs ($)
TPW = Operating Level (tons/week)
Annual Operating Cost ($100,000)
Operating Level, (1000 of tons/week)
0 1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

BASIC LANDFILL COST ASSUMPTIONS

TABLE B-3
ASSUMING EXCAVATION DONE BY RENTED OR LEASED UNIT

50 TPW

EQUIPMENT TABLE A

	CAPITAL COST		OWNING		O&M
Farm Tractor & Loader or Blade	$15,000	@ 22%	$3,600	@24%	$3,300
Fuel	500		119		50
	$15,500		$3,719		$3,350

PERSONNEL COST-TABLE B

Supervisor & Operator @ $11.50/Hr. and fringe for 2 days a week - $184./Wk.
$9568./Per Year

FACILITY COST ESTIMATE- TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$ 9,000	8	720
2.	Preparation	25	12,000	8	840
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	$15,500		3,719
	Sub-Total		$37,500		
5.	Supervision & Inspection	25	2,510	8	201
	Sub-Total		$40,010		
6.	Contingency 10%	25	4,001	8	320
	Sub-Total		$44,011		
7.	Legal 3%	25	1,320		106
	Sub-Total		$45,331		
8.	Bond Discount 3%	25	1,360		109
	TOTAL CAPITAL COST		$46,691		6095.

ANNUAL COST	
A. Sum of 1-8	$6,095
B. Equipment	3,350
Facility CC-3 50% of	500
Miscellaneous 3% of CC-2	360
C. Salaries	9,568
Overhead	
Total Annual Cost	$19,873
Annual Cost/Ton	$ 7.64
@ 52 Weeks	
@ 50 TPW	

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-4

BASIC LANDFILL COST FUNCTION ASSUMPTIONS

100 TPW

EQUIPMENT TABLE A

	CAPITAL COST	OWNING		O&M	
Tractor & Loader or Blade	$15,000	24%	$3,600	30%	$4,500
Fuel	500		119		50
	$15,500		$3,719		$4,550

PERSONNEL COST TABLE B

Supervisor and Operator @ $11.50/Hr. include Fringe for 4 days a week - $19,136

FACILITY COST ESTIMATE TABLE C

		YR	CC	@%	AC
1.	Design	25	$10,000	8	$ 800
2.	Preparation	25	13,000	8	1,040
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	15,500		3,719
	Sub-Total		$39,500		
5.	Supervision & Inspection	25	3,020		242
	Sub-Total		$42,520		
6.	Contingency - 10%	25	4,252		340
	Sub-Total		$46,772		
7.	Legal 3%	25	1,403		112
	Sub-Total		$48,175		
8.	Bond Discount 3%	25	1,445		116
	TOTAL CAPITAL COST		$49,620		$6,449

ANNUAL COST	
A. Sum of 1-8	$ 6,449
B. Equipment	$ 4,550
Facility 50% of CC-3	500
Miscellaneous 3% of CC-2	390
C. Salaries	$19,136
Total Annual Cost	$30,975
Annual Cost/Ton @ 52 Weeks @ 100 Tons	$5.96

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-5

BASIC LANDFILL COST ASSUMPTIONS

250 TPW

EQUIPMENT TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O & M
Crawler	5	$36,000	24	$8,546	22	$8,000
Fuel	5	500	24	119		50
		$36,500		$8,665		$8,050

PERSONNEL COST TABLE B

		ANNUAL
1 Laborer $4/Hr.- 2080	Fringes	$8,320
1 Operator & Supervisor $11.50/Hr - 2080	"	24,000
		$32,320

FACILITY COST ESTIMATE TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$11,000	8	$ 880
2.	Preparation	25	14,000	8	1,120
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	36,500		8,665
	Sub-Total		$62,500		
5.	Supervision & Inspection 2% of 4	25	3,330	8	266
	Sub-Total 10% of 1-3		$65,830		
6.	Contingency 10%	25	6,583	8	527
	Sub-Total		$72,413		
7.	Legal 3%	25	2,172	8	174
	Sub-Total		$74,585		
8.	Bond 3%	25	2,238	8	179
	TOTAL CAPITAL COST		$76,823		$11,891

ANNUAL COST	
A. Lines 1-8	$11,891
B. Equipment	8,050
Facility 50% of CC-3	500
Miscellaneous 3% of CC-2	420
C. Salaries	$32,320
Total Annual Cost	$53,181
Annual Cost/Unit	$ 4.13/Ton

O&M- OPERATION AND MANTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-6

BASIC LANDFILL COST ASSUMPTIONS

500 TPW

EQUIPMENT - TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O&M
Crawler 195Hp	5	$58,000	24	$13,779	24	$13,800
Fuel	5	800		190		100
Scales	10	$ 7,500	14	1,019	8	600
		$66,300		$14,988		$14,500

LABOR TABLE B

Supervisor Scale Man $4/Hr. $5/Hr.	$11,000
Operator @ $11.50 for 2080 Hr.	24,000
Laborer $4.00/Hr. for 2080 Hr.	8,320
	$4 ,320

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$15,000	8	$ 1,173
2.	Preparation	25	20,000	8	1,565
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	66,300		14,988
	Sub-Total		$109,300		
5.	Supervision & Inspection	25	5,626	8	450
	Sub-Total		$114,926		
6.	Contingency 10%	25	11,493	8	919
	Sub-Total		$126,419		
7.	Legal 3%	25	3,793	8	303
	Sub-Total		$130,212		
8.	Bond Discount 3%	25	3,906	8	312
	TOTAL CAPITAL COST		$134,118		$20,350

ANNUAL COST

A.	Line 1-8	$20,350
B.	Equipment	14,500
	Facility ≈50% of CC-3	3,500
	Miscellaneous 3% of CC-2	600
C,	Salaries	43.320
	Total Annual Cost	82,370
	Annual Unit Cost	$3.16/Ton

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-7

BASIC LANDFILL COST ASSUMPTIONS
1000 TPW

EQUIPMENT - TABLE A

	YR.	CC	%	OWNING	%	OPERATION & MAINTENANCE
1 115Hp Crawler	5	$ 36,000	24	$ 8,546	22	$ 8,000
1 170Hp Crawler	5	52,000	24	12,345	22	12,000
1 Fuel Port	5	3,000	24	712	7	200
Scales	10	10,000	14	1,359	10	1,000
		$101,000		$22,962		$21,200

PERSONNEL - TABLE B

Super & Scalemen	1	@ 2080 Hr. @ $8.17/Hr.	$17,000
Equip. Oper. 1.5	1.5	$24,000/Year	36,000
Labor	2		16,640
			$69,640

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	A.C.
1.	Design	25	$ 17,500	8	$1,369
2.	Preparation	25	25,000	8	1,956
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	101,000	-	22,962
	Sub-Total		$151,500		
5.	Supervision & Inspection	25	7,070	8	566
	Sub-Total		$158,570		
6.	Contingency 10%	25	15,857	8	1,269
	Sub-Total		$174,427		
7.	Legal 3%	25	5,233	8	418
	Sub-Total		$179,660		
8.	Bond Discount 3%	25	5,390	8	431
	TOTAL CAPITAL COST		$185,050		$29,611

ANNUAL COST	
A. Line 1-8	$29,611
B. Equipment	21,200
Facility 50% of CC-3	4,000
Miscellaneous 3% of CC-2	750
	$55,561
C. Salaries	69,640
Total Annual	$125,201
Annual Unit Cost at 962 T/W at 52 W/Yr.	$2.50/Ton

O&M- OPERATION AND MAINTENANCE
Yr,- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-8

BASIC LANDFILL COST ASSUMPTIONS

2000 TPW

EQUIPMENT TABLE A

	YR.	CAPITAL COST	%	OWNING	%	O&M
Crawler 195 Hp.	5	$ 58,000	24	$13,770	24	$13,800
Crawler 300 Hp.	5	86,000	24	20,417	22	19,000
Front End Loader 100 Hp.	5	31,000	24	7,360	19	6,000
Fuel Supply	5	5,000	24	1,187	8	400
Scale	10	11,000	14	1,495	14	1,500
		$191,000		$44,229		$40,700

PERSONNEL COSTS TABLE B

Supervisor & Scale	1 @ 2080 @ $8.2/Hr.	$17,056
Laborer	2 @ 2080 @ $4./Hr.	16,640
Equip. Operator	2.5 @ $11.50/Hr and 2080 Hrs.	59,800
		$93,496

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$20,000	8	$ 1,565
2.	Site Preparation	25	30,000	8	2,347
3.	Building Facilities	25	21,620	8	1,691
4.	Equipment	Varies	191,000	-	44,229
	Sub-Total		$262,620		
5.	Supervision & Inspection	25	10,982	8	879
	Sub-Total		$273,602		
6.	Contingency - 10%	25	27,360	8	2,189
	Sub-Total		$300,962		
7.	Legal 3%	25	9,029	8	722
	Sub-Total		$309,991		
8.	Bond Discount 3%	25	9,299	8	744
	TOTAL CAPITAL COST		$319,290		$54,366

ANNUAL COST

A. Lines 1-8	$54,366
B. Equipment	40,700
Facility 50% of CC-3	10,810
Miscellaneous 3% of CC-2	900
C. Salaries	93,496
Total Annual Cost	$200,272
Annual Unit Cost	$2.00/Ton

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC- ANNUAL CAPITAL RECOVERY VALUE

Table B-9

BASIC LANDFILL COST ASSUMPTIONS

5000 TPW

EQUIPMENT TABLE A

NO.	YR.	CAPITAL COST	%	OWNING	%	O&M
1. Crawler 195Hp.	5	$ 58,000		$13,770		$13,800
2. Crawler 300Hp.	5	86,000		20,417		19,000
170Hp.	5	52,000	-	12,345		12,000
1. Loader 300Hp.	5	31,000		7,360		6,000
1. Scraper 150Hp.	5	49,000		11,633		18,000
1. Truck Pick-Up	4	4,000	29	1,160	46	1,840
1. Fuel Truck	5	13,000	24	3,086	35	4,500
1. Water Tank Truck	5	12,000	24	2,849	35	4,000
Motor Grador	5	31,000	24	7,360	13	4,000
Scale	10	25,000		3,397		3,000
		$361,000		$83,377		$86,140

PERSONNEL COSTS TABLE B

5 Operators @ $11.50/Hr. @2080	$120,000	
4 Laborer $4.00/Hr.	33,280	
2 Scale Operator @ $11066./Year	22,132	Based on Ratio of Lab/Sc.Op.
1 Supervisor @ $17,000 @ $8.2/Hr.	17,000	Based on Ratio of Sc. Op/Sup.

FACILITY COST ESTIMATE TABLE C

	YR.	CC	@%	AC
1. Design	25	$ 25,000	8	$ 1,956
2. Preparation	25	40,000	8	3,129
3. Building Facilities	25	27,244	8	2,131
4. Equipment	Varies	361,000	-	83,377
Sub-Total		$453,244		
5. Supervision & Inspection	25	16,444		1,316
Sub-Total		469,688		
6. Contingency 10%	25	46,969		3,758
Sub-Total		$516,657		
7. Legal 3%	25	15,500		1,240
Sub-Total		$532,157		
8. Bond Discount 3%	25	15,965		1,277
		$548,122		$98,184

O&M - OPERATION AND MAINTENANCE
Yr. - NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST

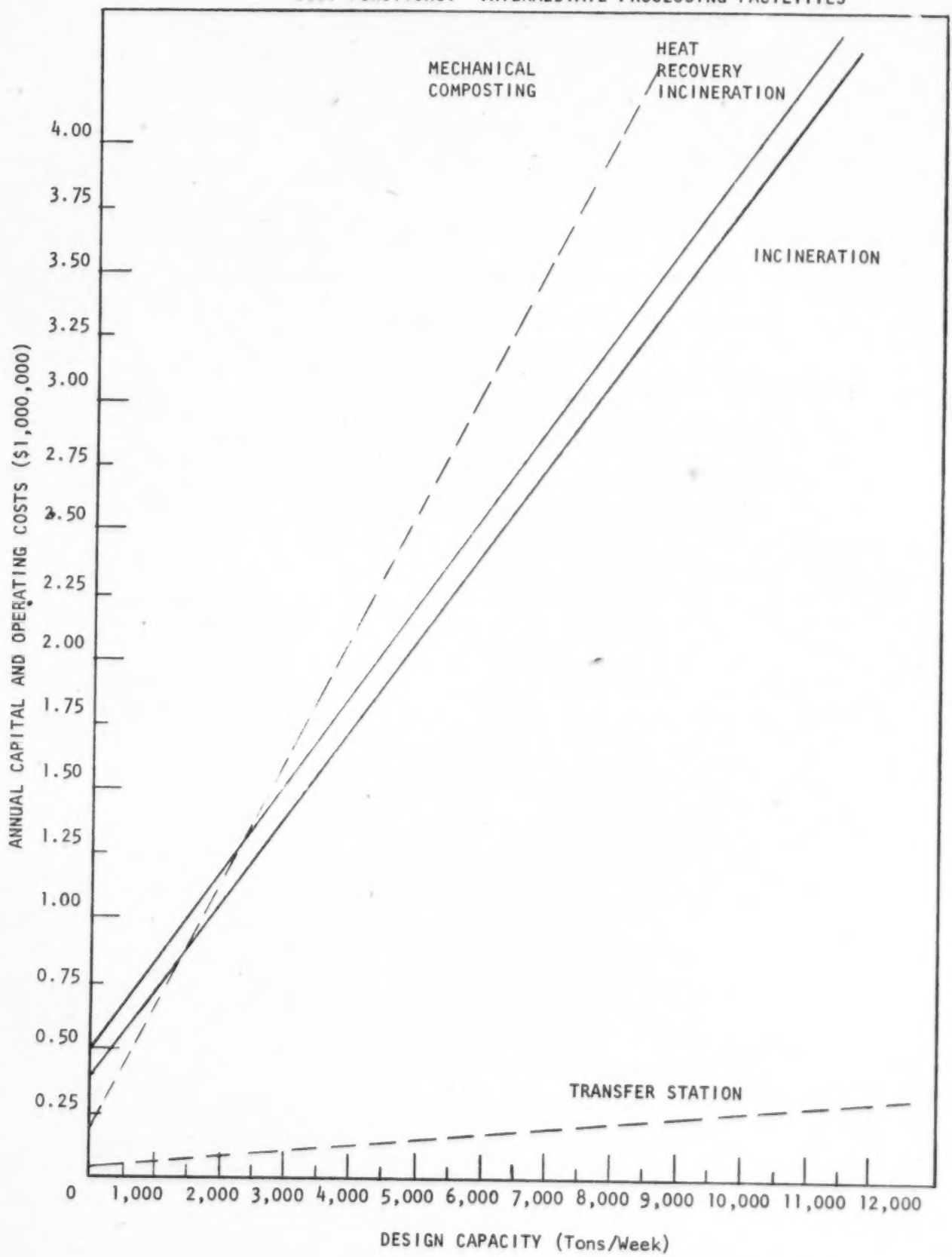
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-9 Continued

A.	Sum 1-8	$98,184
B.	Equipment	86,140
	Facility	13,622
	50% of CC - 3 Miscellaneous	1,200
	3% of CC - 2	
C.	Salaries	$192,412
	Annual Cost	$391,558
	Annual Unit Cost	$1.50/Ton

Figure B-2

COST FUNCTIONS: INTERMEDIATE PROCESSING FACILITIES



EQUATIONS FOR FACILITY COST FUNCTIONS

Transfer Station

$C = 22\ TPW + 40{,}000$

Where C = Annual capital and operating cost ($)

TPW = Design capacity of facility (tons/week)

NOTE: Does not include transport costs.

Compost Plant

Mechanical Digestion:

$C = 500\ TPW + 200{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Cost of residue disposal not included. Approximately 15% of solid waste input must be disposed of when salvage is not practiced; 5% when salvage is practiced.

2) No credit is given for sale of the end product or the salvaged materials. Approximately 33% of the input quantity emerges as compost, and glass and ferrous salvage usually amount to 5% each of the input quantity.

Incinerator

Standard:

$C = 320\ TPW + 400{,}000$

With Power Production

$C = 340\ TPW + 500{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Continuous - feed furnaces

2) Air pollution control equipment included

3) No credit is given for the sale of power

Sanitary Landfill

Capital Cost: Consultant's estimate for each individual case.

Operating Cost:

$C = 84\ TPW + 30{,}000$ when $TPW \leq 3{,}000$
$C = 38.5\ TPW + 160{,}000$ when $TPW > 3{,}000$

Where C = Annual operating cost ($)
TPW = Operating level (tons/week)

The curve that best fit the cost data is described by the following equation:

$$C = 0.62 \log TPW + 3.24$$

Since only linear equations are acceptable to the optimization routine, two linear equations were fitted to the curve aroung the specified breakpoint which yielded the two linear equations above.

RESOURCE RECOVERY FACILITY AND COST

The following system was designed to process up to 750 tons per day of municipal solid waste based upon a 2-shift operation. The system will shred all waste, magnetically separate ferrous metals and separate heavy and light fractions. Two shredders are provided to assure continuous service. The system will produce: shredded fuel, ferrous metals, and a mixture of glass and non-ferrous metals.

This estimate does not include the power plant handling and transportation costs. Included in the building cost is a pile foundation.

This system was designed in 1973 for the City of New Orleans by the National Center for Resource Recovery, but has not been constructed. The construction and operating costs included herein are unvarified estimates of cost.

TABLE B-10

FACILITY (750 Tons/Day, 2 Shift)

	MATERIALS	LABOR
Scale	57,375	6,715
Front End Loader	58,300	-
Municipal Solid Waste Conveyor System	201,235	14,740
Reject Bin (large objects)	6,985	-
Trommel Screen	143,185	11,120
Trommel Discharge Conveyor	12,445	19,085
Shredder Feed Conveyor	20,005	19,085
Shredder (2)	569,615	18,790
Shredder Discharge Conveyor	45,545	805
Air Classifier	270,960	42,190
Magnetic Separator	28,000	7,000
By-pass Conveyor	25,380	2,115
Shredder Materials Conveyor System	58,235	2,115
Heavy Materials Conveyor System	25,875	4,935
Electrical System	51,650	10,075
	$1,574,890	$158,770
Building, Receiving (1,000 Ton Storage)	182,880	14,590
Asphalt Apron	14,750	12,010
Shredder Building	113,305	79,500
	$ 310,935	$106,100
Engineering, Contingencies, Profit	510,385	
Total Cost	$2,661,080	

TABLE B-10 (Continued)

OPERATING COST

Amortization (10 Years @ 8%)	
2,661,080 (CRF 10 Years @ 8%) 0.149 ÷ 12 =	45,500
Power, water	14,538
Shredding	23,469
Recovery	28,608
Cost per Month	$112,015
Total Annual Cost	$1,340,000
750 Tons/Day x 6 Day/Week x 52 Weeks/year = 234,000 Tons/Year	
Cost per Ton =	$5.73
@ 500 Tons/Day x 312 Days/Year = 156,000 Tons	
Cost Per Ton =	$8.60